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KIMBLE PROPERTY - CHARACTERIZATION DATA AND ARSENIC CLEANUP LEVELS

02/14/96

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LETTER

Department of Energy
Fernald Environmental Management Project
P. O. Box 538705
Cincinnati, Ohio 45253-8705
(513) 648-3155

FEB 14 1996

DOE-0333-96

Mr. Paul Pardi
Ohio Environmental Protection Agency
Division of Hazardous Waste Management
401 E. 5th Street
Dayton, Ohio 45402-2911

Dear Mr. Pardi:

KIMBLE PROPERTY - CHARACTERIZATION DATA AND ARSENIC CLEANUP LEVELS

The purpose of this letter is to document information that has been transmitted to your office informally over the last few months to address questions raised in your October 23, 1995, letter to our office and other questions raised in discussions with your office concerning cleanup of the Kimble Property. The first enclosure is a letter from Bechtel to Ed Skintik (November 30, 1995) which provides the characterization plan (location and extent of radioactive and chemical contamination), site maps with sampling locations, revised data summary table and Rumpke approval letter for disposal of non-radioactive soils. The second enclosure is the background sampling results for the Hamilton/Oxford, Ohio area; this enclosure provides surface soil data that supported the cleanup levels of 9.6 mg/kg for arsenic and 20.0 mg/kg (total analysis) that were given in the Remediation Work Plan that was submitted to your office on October 3, 1995. The third enclosure is a letter from Bechtel to Dennis Riley (December 20, 1995) that stressed the need to reassess the cleanup level for arsenic, and proposed changing the cleanup level from 9.6 mg/kg to 20 mg/kg based on included data from four background soil sampling locations on the Kimble Property with soil samples being taken at 6 inch intervals to a depth of 3 feet. In response to a request from Chris Budich on soil description, Bechtel sent to Mr. Budich (fourth enclosure, letter, January 8, 1996) information on the soil classification for the four background samples taken on the Kimble Property and also a document entitled "Soil Survey of Butler County, Ohio" that was prepared by the United States Department of Agriculture and Soil Conservation Service. The fifth enclosure is a summary of five on-site background sampling results (fax, January 17, 1996) for chromium and arsenic, respective soil descriptions and sampling locations on the Kimble Property; a fifth background sample was added to provide a better statistical base for the background data per discussions with your office.

Upon review of the above data, your office proposed that the arsenic cleanup criteria be divided into two tiers: 11 mg/kg for 0 to 2 feet from the surface and 30 mg/kg for depths greater than 2 feet from the surface. Upon review of the conditions at the site and concerns about possibly removing soil that was believed to be background level, Bechtel performed a statistical analysis of the data to resolve two issues: 1) determine whether the data supports that one value can be used for all soil depths; and 2) determine what that background value would be and establish a cleanup level for arsenic based on that data.

The final enclosure is Bechtel's statistical analysis on the arsenic data with the results showing that: 1) one value can be used for all soil depths, and; 2) using the Resource Conservation and Recovery Act (RCRA) closure guidance, a mean plus two standard deviations on the lognormal data gives a value of 26.2 mg/kg for the arsenic cleanup level.

The action level of 26.2 mg/kg for arsenic shall be used as a cleanup standard for soil in those areas that may have been impacted by the storage and/or disposal of the treated wood and ash.

Please provide your concurrence on the above approach to remediating the Kimble Property. If you have any questions, please contact Ed Skintik (513) 648-3151.

Sincerely,

Jack R. Craig
Director

Enclosures: As Stated

cc w/enc:

C. M. Budich, OEPA-SWDO

cc w/o enc:

G. Mitchell, OEPA-SWDO
T. Schneider, OEPA-SWDO
W. Quaider, DOE-FN
D. Riley, DOE-FN
D. Freas, Bechtel National, Inc.

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Bechtel

Oak Ridge Corporate Center
151 Lafayette Drive
P.O. Box 350
Oak Ridge, Tennessee 37831-0350

Facsimile: (615) 220-2100

November 30, 1995

Mr. Ed Skintik
US DOE-FEMP
PO Box 538705
Cincinnati, OH 45253-8705

Dear Mr. Skintik:

As agreed during the November 21 teleconference between Chris Budich of the Ohio Environmental Protection Agency, Angela John of Bechtel Environmental, and yourself, we are providing you the requested materials and information. Included in this transmittal are the following enclosures:

1. Characterization Plan for the Kimble Property

2. Site civil survey map, with two enlargements indicating approximate soil sampling locations (Note that the sample identification numbers are truncated on the map such that only the last two numbers are listed)

3. Revised data summary table

4. Signed (faxed) copy of Chris Russell's concurrence (Rumpke Special Waste Coordinator) agreeing to disposal of non-radioactive soils from the Kimble Property at Rumpke

To identify the presence of mixed waste and to provide adequate waste classification information for the waste disposal facility, a sample strategy was developed that included collection of samples from the different waste forms identified at the site (wood, ash, soil, debris, etc.) and analysis for parameters specified in the Resource Conservation and Recovery Act (RCRA), including toxicity as determined by the toxicity characteristic leaching procedure (TCLP). Ash was found to exhibit the toxicity characteristic for chromium (contains leachable chromium in concentrations that exceeded RCRA limits); no other hazardous materials were identified.

Once the ash was identified as RCRA waste, subsequent sampling of the ash pit (samples KPS-CH-032 through -036) defined the depth of the hazardous waste and the depth of the non-hazardous waste beneath. Soil samples were collected beneath and surrounding the ash material and were analyzed for total metals by inductively coupled plasma atomic emission spectrophotometry (ICPAES) for direct comparison to the site chromium clean up criterion. Four samples were analyzed both for total

chromium and for TCLP-Chromium (KPS-CH-015A, -032A2, -035A2, -041) to correlate the two parameters to ensure that no hazardous waste was inadvertently identified as non-hazardous chromium-containing waste.

In comments provided in the October 23 letter from Mr. Chris Budich to Mr. Jack Craig regarding the Kimble property RemediationWork Plan, Mr. Budich raised several concerns to which we would also like to respond in this letter.

1. Comment: "It is the EPA's position that the arsenically treated wood timbers be considered a demolition waste and not a hazardous waste."

   Response: Redwood will be managed as part of the radioactive wastestream, rather than as part of the hazardous waste stream, at the Kimble site.

2. Comment: "The workplan indicates in Section 4.0 that the soil underlying the redwood storage areas would only be characterized for radiological contamination. Ohio EPA feels that there is a possibility for the leaching of arsenic and chrome from the stored wood. Thus, Ohio EPA requests that DOE evaluate this underlying soil for arsenic and chrome..."

   Response: To determine if chromium, arsenic, or radioactivity leached from the wood onto the soils beneath wood storage areas, these soils were tested for total chromium, total arsenic, and uranium, and were found to contain elevated concentrations of chromium. Soils beneath deteriorated wood also contained elevated uranium concentrations. Chemically and radioactively contaminated materials are being excavated, managed, and disposed appropriately.

3. Comment: "...soil exhibiting levels of [arsenic and chromium] above background [should] be excavated..."

   Response: The work plan identifies site clean up criteria of 9.6 mg/kg arsenic and 20 mg/kg chromium, respectively. Six samples were collected from background locations in the vicinity of the Kimble property. The samples were analyzed for chromium and arsenic by ICPAES, and the analytical results indicate that the above listed criteria are equivalent to background within 2 standard deviations.

If you have any questions or concerns, please contact me at (423) 576-1699. Questions of a technical nature may be directed to Angela John at (423) 576-0410.

Sincerely,

A. J. Boos
Project Manager,
Kimble Property Remediation

Concurrence: A. K John @
J. G. Wood
H. M. Clancy HMC

Enclosures

cc: Dennis Riley, DOE Site Manager (acting), Kimble Property Remediation

WORK INSTRUCTION (WI) JOB NO. 14501-460-461 WI-95-003

REV. 0
SHEET 1 of 19

WI TITLE: Characterization Plan for the Kimble Property Site, Hamilton, Ohio

EXPECTED COMPLETION DATE: 11/24/95

SITE NAME(S) Kimble Property Site SITE WBS NO. 461

ORIGINATING DEPARTMENT: Environmental Technologies

IMPLEMENTING DEPARTMENT: Environmental Technologies

WORK DESCRIPTION AND INSTRUCTIONS:

Scope

The scope of this characterization plan is to identify the location, depth, and horizontal extent of radioactive and chemical contamination present at the property that originated from the Fernald Feed Materials Plant. In addition, this plan includes guidance for the collection of samples necessary for identifying RCRA hazardous components and for profiling the entire waste stream for disposal at Envirocare.

This WI does not include specific instruction on surveying and segregating materials in the debris piles, the bus, or the barns. These activities will be addressed in a site work instruction.

Supplemental sampling needs may be identified in the field during remediation (suspected hazardous components [i.e. lead paint] of materials in the debris piles and barn, fluids in the bus, etc.) General guidance is provided in this document; however, the specific analyses and sampling techniques will be addressed on a case specific basis by the ET team lead via a site work instruction or field change notice/request as appropriate.

CONCURRENCE/~~OPTIONAL~~ PE OR ~~DEPT~~ MGR. TO DETERMINE

HIS William Jones 10-5-95
DEPARTMENT/NAME

WM Tammy Taylor 10-05-95
DEPARTMENT/NAME

DEPARTMENT/NAME

Angela K. Jones
ORIGINATOR

~~TEAM LEAD OR~~ GROUP SUPERVISOR

APPROVED BY: John Wagner
PE OR ~~DEPT~~. MGR.

NOTE: A DOCUMENT ISSUE MEMORANDUM IS REQUIRED TO IMPLEMENT THIS WI.

CLOSE-OUT (IMPLEMENTING DEPT.)

THE TASK HAS BEEN COMPLETED PER THIS WORK INSTRUCTION.

IMPLEMENTOR (NAME/POSITION): _____ DATE: _____

PE OR DEPT MGR.: _____ DATE: _____

000158

DOCUMENT ISSUE MEMORANDUM

To: ADGIE JOHN (recipient)

From: ADGIE JOHN (originator)

Title: Characterization Plan for the Kimble Property

Date Issued: 10/17/95

Rev: 0

ACTION TO BE TAKEN BY THE RECIPIENT:

- [X] For Implementation by : [ ] Construction
  - [X] Other: ET
- [ ] For Use by Engineering and Technology
- [ ] Specification No. _____ Issued to PDCC for Project Use
- [ ] Other _____

INFORMATION COPIES TO:

- [X] Program Mgr. w/o Al Boso
- [ ] Deputy Program Mgr. w/o
- [X] Project Mgr. w/a Dave Freas
- [ ] Project Mgr. w/o
- [ ] Project Eng. Mgr. w/o
- [ ] ESH-WM Mgr. w/o
- [ ] Project Controls Mgr. w/o
- [X] Project Constr. Mgr. w/a Santi Sanchez
- [ ] Project Procurement Mgr. w/o
- [X] Project Eng. w/a Joe Wood
- [ ] Geotech Supervisor w/o
- [ ] Eng. Team Lead w/o
- [X] WM Team Lead w/o Tommy Taylor
- [ ] ET Team Lead w/o
- [ ] H/S Team Lead w/o
- [ ] Env. Comp. Lead w/o
- [ ] TRG Supervisor w/o
- [ ] QA Manager w/o
- [ ] Site Superindentent w/o
- [X] TNS Proj. Mgr. w/a Doug Beard
- [X] TNS Site Lead w/a Jeff Wagner
- [ ] SAIC w/o
- [ ] G. Hartman - FSRD (for QAA/QAP only) w/o
- [ ] PDCC w/original
- [X] Other w/a WADE ADAMS (ORISE) PO Box 117 Oak Ridge TN 37831-0117
- [ ] Other w/o

FOR:

- [X] Work Instruction
- [ ] Scoping/Planning Documents
- [ ] Other _____

Authorized to Proceed:

10/17/95

Proj. Mgr. (if applicable) Date

FOR:

- [ ] Technical Specification No. _____
- [ ] Instruction Guide
- [ ] Quality Assurance Assessments
- [ ] Health / Safety Plan
- [ ] Design Basis
- [ ] Design Drawing No. _____
- [ ] Other _____

Authorized to Issue to PDCC:

Dept. Mgr./Proj. Eng. Date

PI_386

FUSRAP M_013 (9/11/95)

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1.0 Health and Safety

The guidelines stated in the Site Specific Health and Safety Plan for the Kimble Property Site will be followed. As appropriate, Hazardous Work Permits (HWP) will be completed listing the PPE requirements for the individual tasks, and listing hazards associated with the work. Workers will be briefed on HWP contents prior to starting work.

2.0 Site Background Information

The following section provides details of the origin and mechanism of the site contamination. To the extent possible, the characterization team should utilize all available historical and process knowledge coupled with survey data, such that characterization sample locations may be optimally placed.

The Kimble property is a private residence located at 4090 Stillwell Road, in Hamilton, Ohio. The property covers approximately 8 acres, bisected by Stillwell Road into a northern and southern parcel. The northern parcel is approximately 5 acres and contains a barn with attached shed, the property owner's residence, a debris pile, an ash pile, a wood storage pile, and an old school bus. On the southern parcel is another barn, a debris pile, and a drainage ditch/creek. Much of the property is forested (Figure 1).

Uranium contamination (of uncertain isotopic distribution) has been identified on materials originating from Fernald Feed Materials Plant, including treated redwood derived from a cooling tower, a 1943 International school bus, pieces of scrap metal, and other building supplies and debris. The redwood exhibits elevated concentrations of arsenic and chromium as preservatives; these metals were subsequently concentrated in the ash when the material was burned and now represent a contaminant of concern in that waste.

Radioactive contamination on the Kimble property is known or suspected to exist in the following locations:

- Redwood
  - craft constructions (birdhouses, doghouses, squirrel boxes, picture frames)
  - landscaping timbers and lattices
  - baseboard of garage
  - framework of the north and south barn
  - braces of fence
  - storage pile of timbers

- Concrete floor
  - north barn where woodworking was conducted and in the area of the potbellied stove used to burn wood scraps

- Ash from burnt redwood and soils in contact with it
  - ash pit and debris pile

- Debris
  - 1943 International school bus; materials stored within.
  - debris in piles on north and south parcels

A small amount of contaminated redwood was transported from the Kimble property to the Calloway property at 3535 Sneakville Road, Lawrenceburg, Indiana, where it was used for landscaping along the driveway.

3.0 Data Quality Objectives (DQO)

Preliminary sample results indicate that the primary radioactive contaminant on this property is uranium present in natural isotopic abundance. In addition, the redwood ash exhibits concentrations of chromium and arsenic that are near or above the RCRA standards for classification as a characteristic waste. Probable areas of contamination which merit specific targeting during this characterization effort include:

- roof panels near the chimney of the pot belly stove - result of deposition of smoke and radioactively contaminated dust generated during burning of contaminated wood

- floors, expansion joints, floor cracks, subslab soils - in the North barn, ash/debris/saw dust falling to the floor and becoming embedded in or migrating through cracks and joint material

- exterior soils, especially adjacent to areas of known contamination where rainfall could spread the contamination (ash pile, bus, debris piles), adjacent to exterior doors (sweeping scenario), along traffic or storm drainage areas (tracking, intentional or meteorological transport scenario), and along the drip line of the north barn roof (deposition of contaminated particles in smoke from the pot belly stove)

- floor drains, if present

- storm drains, manholes, if present

The Kimble Property Site is residential and the area around the site is sparsely populated; therefore, the possible receptors are residents and site remediation workers. The potential exposure scenarios include direct gamma radiation exposure, and inhalation dose to residents and workers who may come in contact with the contaminated ash or soils.

To quantify the radioactive contaminants at the site, the analytical procedures for soil, ash, and wood samples will be alpha spectroscopy and gamma spectroscopy (soil/ash/wood). Samples

collected for chemical analysis will be analyzed using standard techniques as specified in the Chemical Analytical Services Subcontract (BNI CCN 121143).

The minimum detectable activity (MDA) for analysis of uranium-238 (U-238) by field gamma spectroscopy (if available) shall be less than 5 pCi/g. The MDA for laboratory gamma spectroscopy shall be less than 3 pCi/g. The MDA for isotopic uranium shall be 0.5 pCi/g or lower. The minimum detection limit (MDL) for Arsenic by Inductively Coupled Plasma Atomic Emission Spectrophotometry (ICPAES) shall be less than 4.8 mg/kg, and the MDL for chromium by ICPAES shall be 10 mg/kg.

The Quality indicator goals shall be as follows: Precision, ± 2 sigma; completeness, 90%; Accuracy, ± 25%). Specific quality assurance/quality assessment samples for this characterization are identified in section 4.7.

4.0 General Task Guidance

This section provides general guidance that applies for sampling and surveying activities regardless of the specific location of execution. This general guidance is provided up front to minimize redundancy of instruction in the Task Specific Guidance sections 5.0, 6.0, and 7.0.

4.1 DOE Guidelines and Site-specific Criteria

Characterization results will be evaluated against the guidelines and criteria that will apply to remediation. These guidelines, summarized below, are defined in the Remediation Work Plan.

The residual contamination guidelines for fixed and transferable radioactive contamination (dpm/100 cm^2) is:

Radionuclide	Average	Maximum	Removable
U-Natural, U-235, U-238, and associated decay products	5,000 α	15,000 α	1,000 α
Beta-gamma emitters	5,000	15,000	1,000

- The site-specific contamination guideline for soil is:

Radionuclide	Concentration
Total Uranium	35 pCi/g (above background)

- The clean-up criteria for metals associated with wood ash at the site are:

Metal	Concentration
Arsenic	9.6 mg/kg
Chromium	20 mg/kg

4.2 Decontamination

Perform decontamination in accordance with direction provided in "Instruction Guide for Decontamination of Field Sampling Equipment at FUSRAP Sites (Revision 5)" using the appropriate method for the types of analytes of interest (radiological, organic, or inorganic).

4.3 Coordination with Analytical Laboratories

Coordinate with ThermoNuclear Services according to PI E2.3, "Interaction with the Radiological Support Subcontractor."

Coordinate with Roy F. Weston according to PI E2.4, "Interaction with the Chemical Analysis Subcontractor."

Coordinate with Applied Geotechnical Engineering Associates (AGEC) according to PI E2.7, "Interaction with the Geotechnical Analysis Subcontractor."

4.4 Sample Identification

Sample IDs shall conform to the general format: KPS-CH-### for the Kimble Property. All samples from a single borehole will be assigned the same sample ID with a different two-letter depth identifier (AB for increment 0-1'; CD for increment 1-2', etc.) All samples shall be labeled in sequential order, regardless of the matrix. Each QA/QC sample will be identified according to the applicable sample ID followed by an additional two- or three-letter identifier: -DP for field duplicate, -MS for matrix spike, -MSD for matrix spike duplicate. Rinse blanks shall be labeled KPS-RB-Month/day of collection.

4.5 Field Screening of Samples

Immediately after sample collection, screen each sampled soil increment to assess if adequate depth has been sampled in the particular borehole. Screen the sample in its sample container in an area with low background radiation using a portable beta/gamma survey instrument (shielded HP-210 or equivalent) set for a 1 minute count. An equivalent count using an empty sample container may serve as the blank. The screening and background result, the detector serial number, and calibration date will be recorded in a field logbook along with the field observations specific to that borehole/sampling location.

4.6 Sample Analyses

Request analysis of soil and ash samples by gamma spectroscopy (list 1 and 2) for 100% of the samples and isotopic-Uranium (iso-U) by alpha spectroscopy for 5% of the samples. If field gamma spec capabilities are available, analyze all samples in the field lab, then submit to the lab 5% for gamma spec list 1 and 2, and iso-U.

Note: The purpose for analyzing for iso-U (alpha spectroscopy) is to determine the ratios of the uranium isotopes to verify the type of contaminant (natural uranium, depleted, enriched). The sampler should preferentially analyze for iso-U those samples that field screening indicates are significantly contaminated. In addition, the disposal facility requires alpha spectroscopy data for uranium; therefore, iso-U data is necessary for all components of the waste stream.

For alternate types of media (wood, etc.) to be analyzed for waste classification request iso-U and gamma spec list 1 and 2.

Chemical analyses for waste classification include:

- Total Toxicity Characteristic Leachability Procedure (TCLP-total)
  TCLP-volatiles, -base/neutral/acid extractable organics, -pesticides, -herbicides, and -metals (including Zn and Cu)];
- Extractable Organic Halides (EOX);
- Reactivity-S, Reactivity-CN;
- Flashpoint;
- Corrosivity-pH (for two soil/ash samples and any liquids sampled); and
- Paint Filter liquids (1 sample from each matrix).

Samples for bounding the depth and horizontal extent of chemical contamination should be analyzed for arsenic and chromium by Inductively Coupled Plasma Atomic Emission Spectrophotometry (ICPAES).

Geotechnical analyses will consist of particle size analysis, moisture content, compaction test, vibratory free liquids, visual classification, and specific gravity.

4.7 Quality Control Samples/Surveys

- Collect one rinse blank from the sampling equipment for each day of sampling and analyze for those parameters being sampled on that day. As applicable, collect a rinse blank for iso-U, Total Organic Halogens (TOX), and ICPAES. To the extent feasible, attempt to minimize the number of days on which chemical samples are collected to limit the number of rinse blanks required. If laboratory grade concentrated nitric acid is not available at the site for preservation of samples for radiological analysis, indicate on the field sample collection form that the laboratory shall preserve upon receipt.

- Collect field duplicate samples and survey measurements at a frequency of 1 duplicate for every 20 samples/survey measurements. Do not collect duplicates for TCLP analysis or for geotechnical parameters, including the paint filter test.

- Collect one matrix spike sample for each 20 samples analyzed for TCLP. Collect one matrix spike/matrix spike duplicate set for every 20 samples analyzed for EOX and for every 20 samples analyzed for ICPAES.

4.8 Identification of Borehole Locations

A civil survey of the property will be conducted during the first few weeks of field work.

Document sampling locations by measuring from two permanent structures or features (i.e. benchmarks) indicated on the civil survey, with the goal of obtaining measurements that are reproducible within ±3 feet. Record sampling locations in the sample logbook so that the points can be relocated on figures by CADD.

4.9 Logbook Maintenance, and Sample Packaging and Shipping

Maintain field activity records in accordance with general guidance in PI E2.9, "Control of Field Logbooks."

Package and ship all samples in accordance with PI R4.7, "How to Ship Samples from a FUSRAP Site."

Ship samples for analysis for radioactive parameters via Airborne to:

ThermoNuclear Services (TNS)
601 Scarboro Road
Oak Ridge, TN 37830
Attn: Sample Log-in

Ship samples for analysis for chemical parameters via Airborne to:

Roy F. Weston, Inc.
208 Welsh Pool Road
Lionville, PA 19341
Attn: Sample Log-in

IMPORTANT NOTE: To minimize analytical cost, if analytical holding times permit, attempt to ship chemical samples in batches of greater than two samples (different ID#).

Ship samples for analysis for geotechnical parameters via Airborne to:

Applied Geotechnical Engineering Consultants (AGEC)
c/o Mountain States Analytical
1645 West 2200 South
Salt Lake City, Utah 84119
Attn: Scott Frazier

Ship samples to Envirocare via UPS Ground no more than 90 days prior to anticipated receipt of waste at Envirocare:

Envirocare of Utah, Inc.
Attention: Sample Control
Tooele County, USI-80, Exit 49
Clive, Utah 84029

NOTE: When shipping via UPS Ground, pickup must be scheduled one day in advance. Exact shipment weight is required at the time of the call for pickup. Payment must be cash (no account).

4.10 Waste Management

Containerize personal protective equipment (PPE), discarded sampling equipment, contact wastes, and other waste generated during the sampling activities. If the waste is contaminated above DOE's release criteria, dispose of as radioactive trash. Waste that is not contaminated above the DOE release criteria may be disposed of as municipal trash. Decontamination fluids will be containerized for disposal at Fernald. Drill spoils will be drummed (ash pile) or placed in LSA containers (soils), as directed by the site superintendent.

5.0 Specific Task Guidance - Field Surveying

5.1 Site Background Research

5.1.1 To optimally utilize process and historic information in identifying potentially contaminated areas, request a tour of the site from the property owner. Ask the following questions:

- Was ash disposed of anywhere other than the ash pit and debris piles? For example, was ash used as a soil amendment in a vegetable or flower garden? Was ash swept out of any doorways in the barn? Was the chimney of the potbellied stove cleaned out?

- Where was sawdust disposed of? Was sawdust swept out of the barn doorways?

- Was waste buried anywhere on the property? Used to fill in holes?

5.1.2 Collect background soil samples and measurements as directed in TMA Procedure 3C.2 "Determination of Background" and consistent with the Post Rememdial Action Survey Plan as agreed upon by the independent verification contractor.

5.2 Exterior Grounds Gamma Walkover

5.2.1 Clearly delineate a site grid. According to the property owner, a civil survey of the property was conducted and there is a benchmark on the property. If a separate coordinate system is established, all grids must be referenced to the benchmark on the property.

5.2.2 Conduct a systematic gamma walk-over survey using a FIDLER or equivalent in all exterior areas of the site. Walkover rate will be adequate to detect measurements of twice background or greater. Record all survey results in detail. This information will be used to identify sampling locations. For areas that are inaccessible, but that will be made accessible (i.e. debris piles), indicate such on the survey form and complete the survey once the obstacle is removed.

5.2.3 Conduct biased walkover scans in the following areas that have been identified as having a higher potential for radioactive contamination:

1. the proposed footprint for the new barn (north parcel)
2. the stream/ditch area of the property (north and south parcel)
3. any other low spots to which drainage would run from areas of know contamination
4. around the bases of trees where animal houses were mounted
5. at the drip line of the roof of the north barn (where the pot belly stove was used to burn redwood)
6. the soil beneath the bus, once the bus is dismantled and removed

5.2.4 If gamma survey measurements exceed 2 times background, the hottest spot and the extent of the apparent surface contamination should be indicated using pin flags. In paved or graveled areas, hotspots may be identified using spray paint, paint pen, or carpenter's crayon (as appropriate and as approved by the property owner).

5.3 Direct/Transferrable Contamination Surveys

5.3.1 When encountered, survey concrete drains for direct beta/gamma radioactivity. If any direct readings exceed 1,000 dpm/100 cm^2, take measurements for transferrable beta/gamma and direct and transferrable alpha radioactivity.

5.3.2 Once the barns are emptied of material, perform a gamma walkover of the floors. Alternatively, if a floor monitor is available, utilize that instrument first and identify general areas of contamination. Delineate any contamination boundaries using hand-held instrumentation as appropriate.

Pay special attention to the expansion joints and/or floor cracks (north barn), which are areas with the greatest potential for contamination. Mark any hot spots using spray paint or a paint pen. Record hotspot locations and readings in a field logbook or equivalent.

5.3.3 Survey any other interior areas that process knowledge suggests are likely to have become contaminated, applying the general survey guidance described in Section 5.3.1.

5.3.4 As the north barn is dismantled, survey roofing material (as described in 5.3.1) that is removed from the area surrounding the location of the chimney of the potbelly stove. Contaminated particles in the smoke might have settled onto the roof and been retained in rough areas of the roofing.

5.3.4 Where contamination may be expected based on proximity to contaminated materials, scan the contacting area to confirm the radiological status. Compare scan results to DOE surface criteria. Areas of concern include tree trunks where bird and squirrel houses were mounted and the drip-line along the trunk below; walls where contaminated base boards or picture frames were hung; etc. Utilize the general methodology described in Section 5.3.1.

6.0 Specific Task Guidance - Chemical and Radiological Sampling

The following section provides location-specific sampling guidance. It includes guidance for both characterization and waste classification sampling and analysis for chemical and radioactive constituents. The analyses specified in the sections below are recommendations and may be revised by the ET lead based on process knowledge or field observations. Up to six samples of waste stream material should be analyzed for the waste classification parameters, as deemed appropriate by the ET and WM lead during characterization. To save analytical cost, if holding times will permit, the ET lead may elect to retain some samples on-site pending preliminary results from other increments.

6.1 Ash Pit - Determination of Depth of Contamination

6.1.1 Identify two to four locations in the ash pit with elevated gamma survey readings, and mark the location(s) for sampling to determine depth of contamination.

6.1.2 Using appropriately decontaminated tools (stainless steel hand augers, spoons, and bowls) collect samples of soil from each 6" depth increment.

6.1.3 For determination of depth of contamination, continue sampling 6" beyond the bottom of the ash-like material (as determined by visual observation) or to the depth where field screening indicates that the bottom of radioactive contamination has been reached, whichever occurs deepest.

6.1.4 In the sampling logbook, record the depth of ash-like material.

6.1.5 Analyze the 2 most radioactively contaminated increments (as indicated by field screening results) for iso-U, gamma spec list 1 and 2, all standard waste classification parameters (only one sample for corrosivity-pH, flashpoint, and paint filter test), and ICPAES (As, Cr).

6.1.6 Analyze all other increments for gamma spec list 1 and ICPAES (As, Cr).

6.1.7 Collect MS/MSD and FD for the applicable analyses as directed in Section 4.7.

6.2 Ash Pit - Determination of Horizontal Extent of Contamination

6.2.1 Identify the horizontal boundaries of the contamination as the point where FIDLER (or equivalent) readings decrease to less than two times background. Select up to 6 locations that will serve to delineate the boundary of the ash pit(s).

6.2.2 Using appropriately decontaminated tools (stainless steel hand augers, spoons, and bowls), collect samples of soil from 6" depth increments to a depth equivalent to the depth of contamination in the pit. Field screening results should indicate near background measurements for radioactivity for all bounding samples.

6.2.3 Submit samples for analysis for gamma spec list 1 and ICPAES (As, Cr).

6.3 Soils Associated with the Debris Piles, Subslab, Bus, and Wood Storage Piles

6.3.1 Once the underlying soil of the debris piles is exposed, utilize gamma walkover surveys to identify the area with highest measurements of radioactivity. If no elevated survey results are identified, select a location based on physical characteristics: ash-like appearance; low or moist indicating drainage to that location.

Determine depth of contamination at one location in each debris pile by collecting samples at 6" increments to a depth of 1' or until field screening indicates background readings for radioactivity, whichever occurs deepest. Use the methodology described for the ash pit (Section 6.1). Analyze the first increment for gamma spec list 1 and 2, Iso-U, waste classification parameters, and ICPAES (As, Cr). Collect only one sample for corrosivity-pH. Do not collect samples for paint filter or flashpoint. Analyze all deeper increments for gamma spec list 1 and ICPAES (Cr, As) only. If the ET team lead or designee deems it appropriate, collect soil samples from up to 3 locations for each pit to bound horizontal contamination. Utilize the same techniques as are described in Section 6.2.

6.3.2 As the slab of the north barn is being removed, identify the area of greatest radioactivity (if present). If no elevated radioactivity is noted, select a location in the area of floor crack/expansion joint nearest the former location of the pot belly stove. Determine the depth of contamination as described in step 6.3.1, analyzing for gamma spec list 1 and

ICPAES (As, Cr) in each 6" increment to a depth of 1' or until the bottom of the contamination is reached (field screening), whichever occurs deepest.

6.3.3 If elevated measurements of radioactivity are identified in the soils beneath the bus, collect samples from 1 location at 6" increments until the bottom of the radioactive contamination is reached or to a depth of 1', whichever occurs deepest. For the first increment, request analysis for gamma spec list 1 and 2, iso-U, waste classification parameters, and ICPAES (As, Cr). Do not analyze for paint filter or corrosivity-pH unless the physical appearance of the soil differs dramatically from other soil samples collected and analyzed for those parameters. For all deeper increments, analyze for gamma spec list 1 and ICPAES (As, Cr). If no elevated radioactivity measurements are detected, collect a 6" depth sample in the general location that underlay the bus' gas tank using visual cues to identify a location.

6.4 Drainage Areas

6.4.1 In drainage areas (ditches, creek in southern parcel), if walkover surveys indicate elevated radioactivity measurements, collect samples at 6" increments to a minimum depth of 1' to determine depth of contamination. Request analysis for gamma spec list 1 and ICPAES (As, Cr).

6.4.2 If no elevated measurements are identified in the stream/ditch, use visual cues to select an area of sediment deposition (i.e.: interior curve of a meander, etc.) downstream of the areas of known contamination (especially the ash pits), and collect the samples described in the previous step.

6.5 Discretionary Sampling: Other Hot Spots

6.5.1 If the sampling team lead determines it to be appropriate, along the drip line of the roof of the North barn, based on gamma walkover survey readings and visual cues, select one sampling location. To determine if contaminated ash/smoke were deposited on the roof and washed to the ground, sample at 6" increments to a depth of 1' and analyze for gamma spec list 1 and ICPAES (As, Cr).

6.5.2 At any other locations identified by gamma walkover to be contaminated and not specifically called out in the above sections, determine depth of contamination by sampling 6" increments to a minimum depth of 1' or until field screening indicates the bottom of contamination has been reached. Analyze by gamma spec list 1 and ICPAES (As, Cr).

6.6 Wood Samples

6.6.1 To confirm the uniformity of the wood for disposal, collect 2 - 3 samples from different locations at the site: 1 sample of wood that has spent the majority of its on-site time sheltered from weathering, 1 sample from the Kimble Property that has been outside

during its on-site time. Sources of wood to be sampled could include the barns, animal houses, wood pile. For the sample that was not exposed to the elements, request analysis for gamma spec list 1 and 2, Iso-U, and all waste classification parameters excluding paint filter and corrosivity. For all other wood samples, at a minimum request analysis by gamma spec list 1; TCLP-metals, Cu, Zn; and TCLP-BNAE (semi-volatiles).

6.7 Miscellaneous Waste Stream Samples

6.7.1 During remediation/removal activities, as radiologically contaminated wooden constructions, debris, etc. are identified, examine each piece for paint. If paint is present, sample each distinct type for TCLP-metals (TCLP-Pb and -Cr, at a minimum).

6.7.2 While dismantling the bus for disposal, identify any unique components that may represent a distinct portion of the waste stream (i.e. gasoline, oil, lubricants, paint, etc.) and sample for the waste classifications deemed appropriate.

6.8 Calloway Property Samples

6.8.1 Collect 1 - 6" soil sample from beneath the redwood timbers and analyze for ICPAES (As, Cr) and gamma spec list 1.

7.0 Specific Task Guidance - Waste Classification Sampling

In addition to the samples for chemical and radiological analysis collected as part of waste classification, geotechnical and waste stream representative samples must be collected. Details of sampling for chemical and radiological waste profiling are discussed in section 6.0.

7.1 Geotechnical Samples

7.1.1 Using a shovel or other applicable tool collect a 50 - 70 lb. soil sample representative of the soil in the waste stream. Place the sample in an 8-gallon drum lined with a plastic bag. At a minimum, a sample of the ash/soil material in the ash pit should be analyzed for the geotechnical parameters. If substantial quantities of soil from a different location (i.e. beneath bus, subslab North barn) are identified, one additional 50 - 70 lb. soil sample should be collected. At a minimum, for all distinctly different soils that will comprise the waste for disposal, vibratory free liquids must be determined.

NOTE: The purpose of this sample is to determine the geotechnical properties of the soil that will comprise the waste stream. To the extent possible, the 50-pound soil sample should be from an area known to have relatively low concentrations of radioactive contaminants, based on field instrument readings. The lowest radioactivity possible is desired to prevent contamination of the laboratory; however, the sample must be representative of the material for disposal.

7.1.2 Twist and tape the plastic bag shut inside the drum. Fill the void space with packing material to minimize shifting of the sample during shipment.

7.1.3 Request analysis for particle size analysis, compaction test, vibratory free liquids, visual classification, moisture content, and specific gravity. Place a completed chain of custody form and analytical services request in a ziplock bag and tape to the inside of the drum lid.

7.1.4 Ship to AGEC as instructed in section 4.9.

7.2 Envirocare Waste Stream Component Sampling

7.2.1 Samples are provided to Envirocare for them to determine the range of properties to expect in the waste stream generated during RA of the site. To meet this objective, collect a 2-pound sample of each of the anticipated components of the waste stream.

7.2.2 Collect at least five 2-pound samples, using any tools deemed appropriate. Include one each of the various waste stream components identified during characterization. As additional components are identified during remediation, collect 2-lb samples of those materials as appropriate.

NOTE: It is anticipated that the waste stream will consist of ash-like material, soil, wood, metal debris, and some concrete. If any other distinct waste stream components are identified in the debris piles or elsewhere, 2-lb samples of that material should also be submitted.

7.2.3 For each sampled waste stream component, fill a 1-gallon paint can (lined with a ziplock plastic bag) with a 2-pound soil sample. Seal the plastic bag shut, and label the sample in sequential order: KPS-##.

7.2.4 Place chain-of-custody labels on each paint can, and prepare BNI labels and chain-of-custody forms for documentation. The waste management logistics coordinator shall provide DOT labels, markings, and shipping papers, as appropriate and shall determine the optimum time for shipment.

7.2.5 Package the paint cans in fiberboard boxes such that the composite package is a strong tight container, i.e., a container that will maintain its integrity throughout transportation during conditions normally incident to transportation. Ship as directed in section 4.9, when instructed to do so by the Transportation and Logistics Coordinator.

8.0 Suggested Equipment

General

1	Spill kit
1 set	Hand tools (i.e.: wood chisels, hammer, mallet, adjustable wrench, shovel)
10	3" bucket augers with 2 handles, 4 extensions, clips
12	Stainless steel bowls and spoons
1	Scale capable of measuring to 70 pounds
2	100 foot tape measures
100	Pin flags
1 roll	Plastic sheeting
300 ft	Rad rope
2 rolls	Caution tape
16 rolls	Paper towels
2 cans	Spray paint, any color
2	Paint pens for marking concrete/asphalt
8	barricades
4	sawhorses
1	freezer for freezing blue ice

Sample labeling and paperwork

2 box	Indelible ink-pens (black ink)
2 box	Sharpie permanent markers (fine and medium point)
2	Clip boards with compartment to keep papers clean and dry

Sample Packaging

6	One-gallon cubitainers with lids and boxes for rinse blanks
1	Large box of styrofoam peanuts for packing
5 bags	Vermiculite
100	Bubble-wrap bags to cushion bottles during shipment
10	One-gallon metal paint cans for Envirocare samples
30	1-gallon Ziplock plastic bags for paint can lining
20	Fiberboard boxes for packaging samples
2	Eight-gallon metal drum for AGEC sample, with lid and ring
3	Plastic liners for metal drum (12 gallon garbage bags)
10 rolls	Packing tape
5 rolls	Duct tape
10 rolls	Electrical tape

Personnel and equipment decon and preservation supplies

3	Box alconox powder
10	5 to 10-gallon plastic buckets with lids
2	Teflon squeeze bottles
1 btl	Isopropyl alcohol

1 btl	10% HNO_3
1	Stainless Steel Sprayer for DI water
2	Soft bristle brush (toilet brush)
2	Small kitchen sink brush
2	Rolls aluminum foil
1	Stainless steel funnel
2	10 mL graduated cylinder (glass)
2	Dispensers with pH paper
1	Set of goggles, heavy gloves, and apron

Sampling Waste Management

2	55-gallon drums for sampling waste and soil cuttings and water
1	drum dolly for maneuvering drums
1 roll	Rad bags
1 roll	large garbage bags

PPE

1 boxes	Tyvek (large and extra large)
2 boxes	phthalate free gloves (large)
50 pairs	cotton glove liners
25 pairs	cotton work gloves
1 box	booties
3	hardhats
3	pairs safety glasses
3	pairs safety sunglasses
4	pairs Rain suits (2 medium, 2 large)

Records (supplied by ET Representative at Oak Ridge Office)

	Required forms (chain-of-custody forms, airbills, field sample collection forms, analytical services forms, etc.)
1 roll	Chain of custody seals
1 each	Field logbooks (radioactive and chemical)

Survey and Health and Safety Monitoring Equipment (provided by TMA)

	Radiation detection instruments, supplies, calibration sources
	Floor monitor
50	Metal labels for nalgene jars

Chemical Sample Supplies (provided by Weston)

6 sets	Bottles, lids, labels for chemical analysis
	Vermiculite to cushion sample bottles and absorb leaks
2	Coolers for packaging chemical samples
15	Blue ice to cool samples in transit
4 cases	HPLC water

9.0 References

BNI, 1995. Remediation Work Plan - Kimble Property, Hamilton, Ohio

BNI, 1995. Site Specific Health and Safety Plan Kimble Property, Hamilton Ohio, Decontamination and Restoration. Revision 0. July 1995 (KPR-002)

Chemical Analytical Services Subcontract (BNI CCN 121143).

FUSRAP, "Work Instruction for Analysis of Soil Samples by High Resolution Gamma Spectroscopy" WI-95-034 Rev. 1.

FUSRAP, "Instruction Guide for Decontamination of Field Sampling Equipment at FUSRAP Sites (Revision 5)" 191-IG-011

FUSRAP, "Control of Field Logbooks", PI E2.9

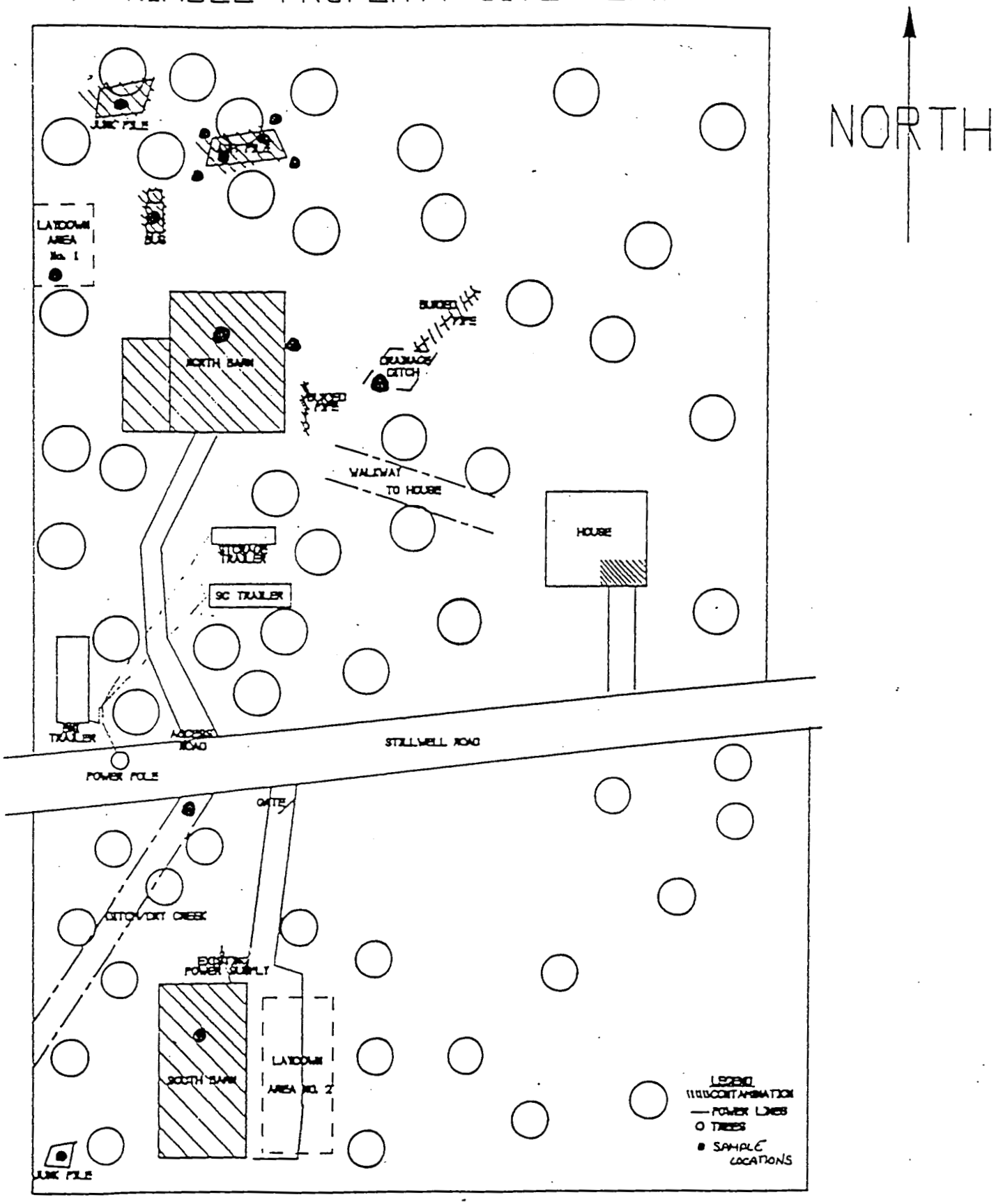
FUSRAP, "How to Ship Samples from a FUSRAP Site", PI R4.7

FUSRAP, "Interaction with the Radiological Support Subcontractor", PI E2.3

FUSRAP, "Interaction with the Chemical Analysis Subcontractor", PI E2.4

ThermoAnalytical (TMA), Health Physics Operational Procedures Manual
- 3C.2 "Determination of Background"
- 3B.1 "Delineation of Survey Areas in Open Land"
- 3A.2 "Direct Surface Contamination Survey"
- 3A.3 "Transferable Surface Contamination Survey"
- 4A.1 "Systematic and Bias Surface Soil Sampling (Radiological)"

KIMBLE PROPERTY SITE PLAN

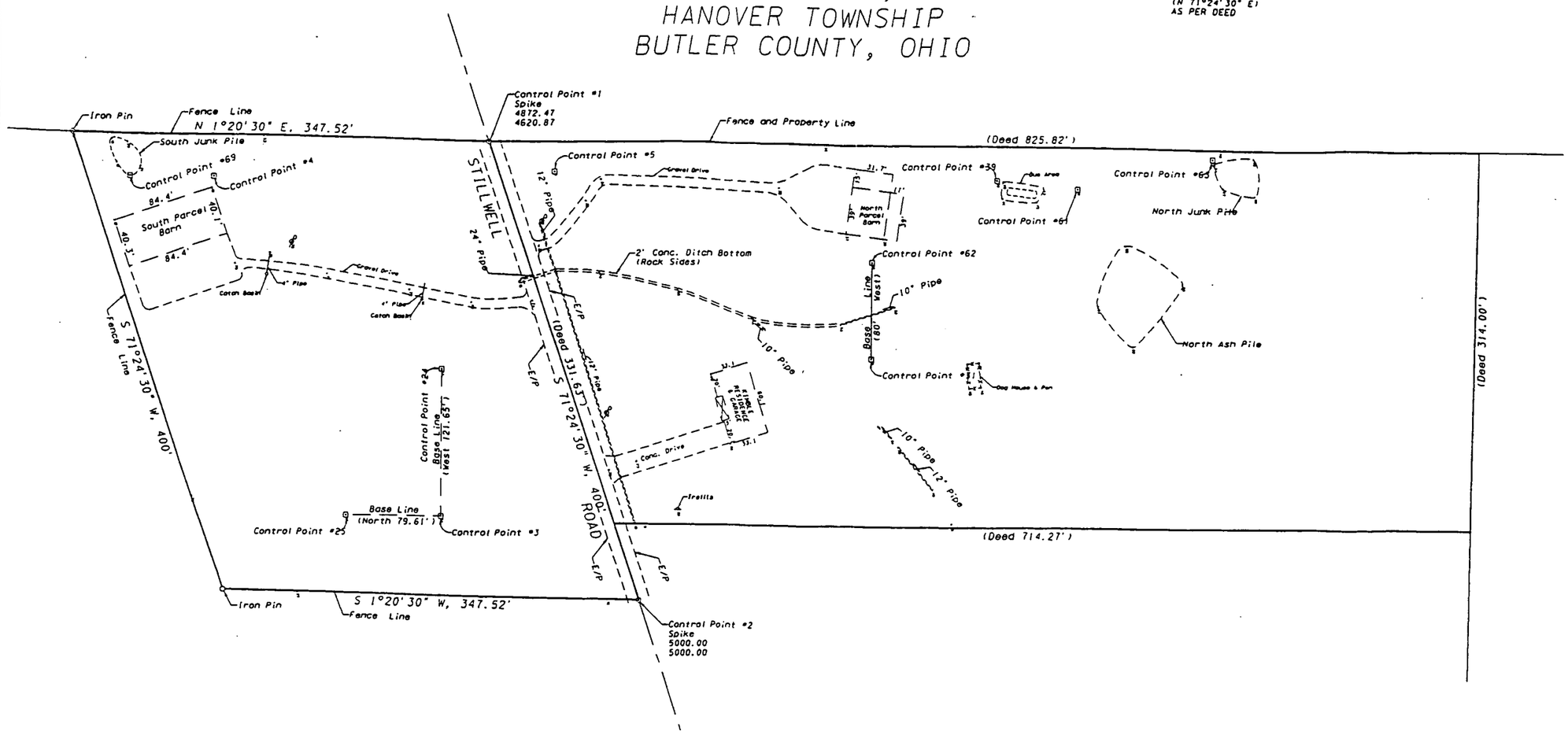


NOT TO SCALE

FIGURE 1: Kimble Site Layout and Potential Sampling Locations

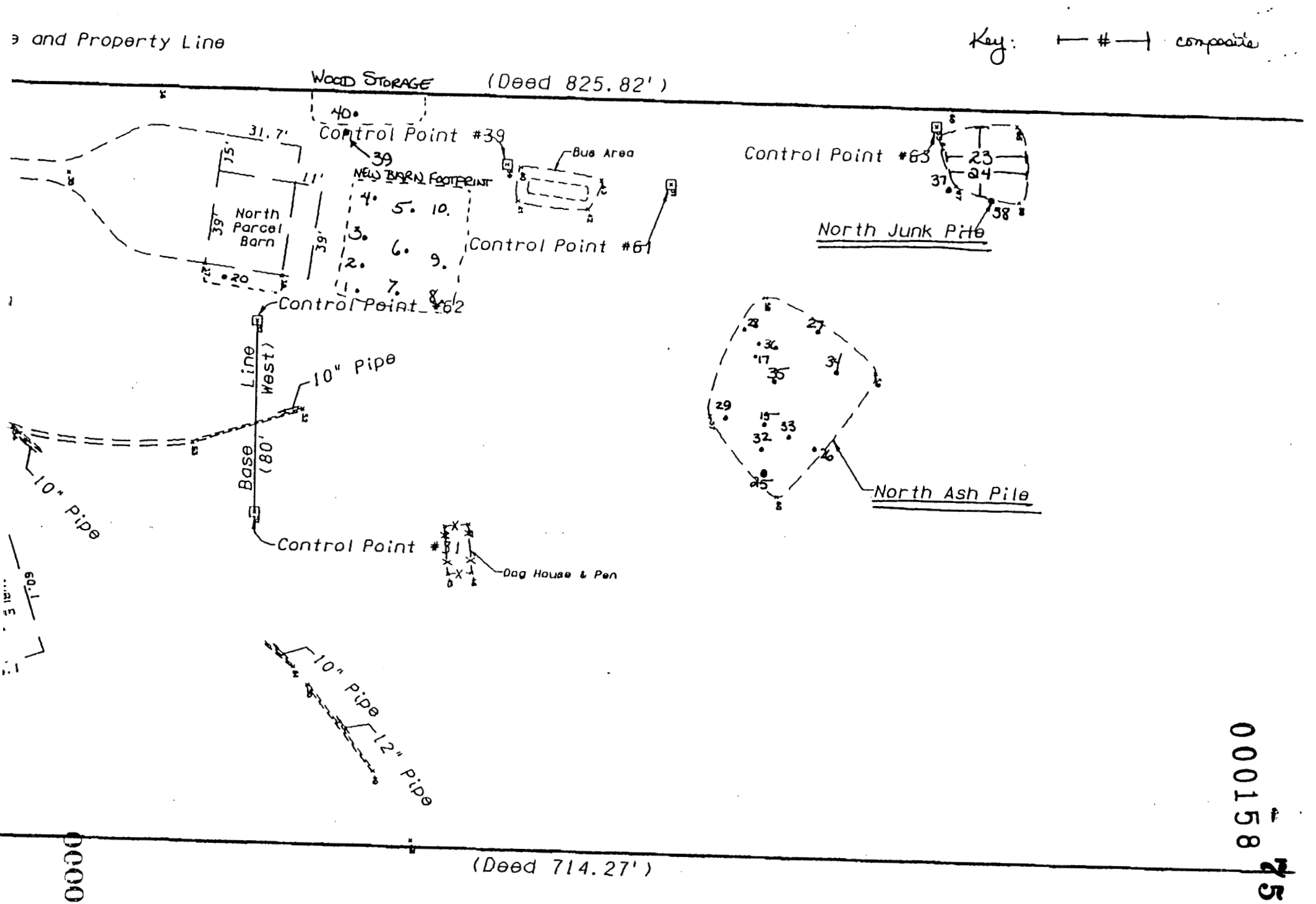
SITE SURVEY
KIMBLE PROPERTY
14501-460

SECTION 18, TOWN 4, RANGE 2
HANOVER TOWNSHIP
BUTLER COUNTY, OHIO



BROSEY SURVEYING COMPANY
4045 STILLWELL ROAD
HAMILTON, OHIO 45013

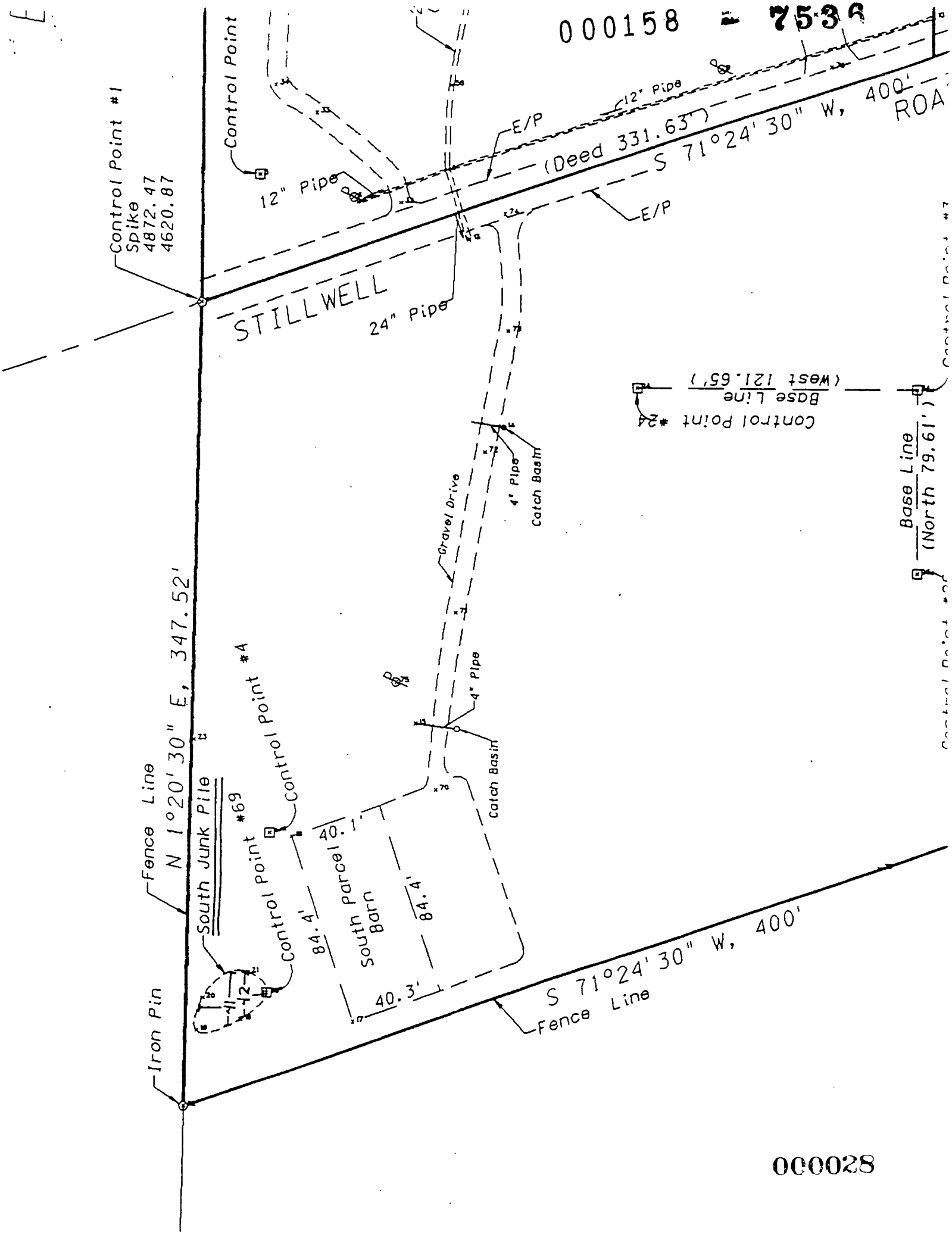
SEPT. 26, 1995



000027

000158

7536


Control Point #1
Spike
4872.47
4620.87
Control Point
12" Pipe
E/P
12" Pipe
(Deed 331.63')
S 71°24' 30" W, 400'
ROA
E/P
STILLWELL
24" Pipe
Control Point #24
Base Line
(West 121.65')
Control Point #3
Base Line
(North 79.61')
Gravel Drive
4" Pipe
Catch Basin
4" Pipe
Catch Basin
Control Point #4
Control Point #69
South Junk Pile
Fence Line
N 1°20' 30" E, 347.52'
40.1'
84.4'
South parcel
Barn
84.4'
40.3'
S 71°24' 30" W, 400'
Fence Line
Iron Pin

Kimble Characterization Samples

Sample ID	Matrix, Location	Depth	RCRA Fail? (a)		Total Uranium			Chromium		Arsenic		Suggested
		(feet)	>5mg/L	Result	Result	>background?	>35 pCi/g?	Result	>20 mg/kg?	Result	>9.6 mg/kg?	Disposal (b)
KPS-CH-001	Soil, New barn footprint	0.50	---	---	3.39	No	No	---	---	---	---	Clean
KPS-CH-002	Soil, New barn footprint	0.50	---	---	3.16	No	No	---	---	---	---	Clean
KPS-CH-003	Soil, New barn footprint	0.50	---	---	3.23	No	No	---	---	---	---	Clean
KPS-CH-004	Soil, New barn footprint	0.50	---	---	7.29	No	No	---	---	---	---	Clean
KPS-CH-005	Soil, New barn footprint	0.50	---	---	3.08	No	No	---	---	---	---	Clean
KPS-CH-006	Soil, New barn footprint	0.50	---	---	3.39	No	No	---	---	---	---	Clean
KPS-CH-007	Soil, New barn footprint	0.50	---	---	3.83	No	No	---	---	---	---	Clean
KPS-CH-008	Soil, New barn footprint	0.50	---	---	6.12	No	No	---	---	---	---	Clean
KPS-CH-009	Soil, New barn footprint	0.50	---	---	4.05	No	No	---	---	---	---	Clean
KPS-CH-010	Soil, New barn footprint	0.50	---	---	3.87	No	No	---	---	---	---	Clean
KPS-CH-011	Wood (from DOE)	---	No	Cr=1.42	---	---	---	---	---	---	---	---
KPS-CH-012	Wood baseboard	---	No	Cr=0.344	169.50	Yes	Yes*	---	---	---	---	Rad
KPS-CH-013	Wood shingle	---	No	Cr=0.671	63.00	Yes	Yes*	---	---	---	---	Rad
KPS-CH-014	Wood painted (white)	---	Yes (Pb)*	63	---	---	---	---	---	---	---	Mixed
KPS-CH-015A	Ash pit - E depth	0.50	No	Cr=0.271	55.50	Yes	Yes*	709	Yes	8.1	No	Rad
KPS-CH-015B	Ash	1.00	(No)		14.20	Yes*	No	107	Yes*	5.5	No	(Rad)
KPS-CH-016A	Ash, -015A duplicate	0.50	(No)		69.30	Yes	Yes*	683	Yes	8.7	No	Rad
KPS-CH-017A	Ash pit, W depth	0.50	No	Cr=0.725	48.00	Yes	Yes*	---	---	---	---	Rad
KPS-CH-017B	Ash	1.00	(No)		16.98	Yes*	No	169	Yes*	6.2	No	(Rad)
KPS-CH-017C	Ash	1.50	(No)	---	8.40	Yes*	No	83.3	Yes*	10.2	Yes	(Rad)
KPS-CH-018	Ash , N barn stove	---	Yes (Cr)*	1760	514.50	Yes	Yes*	---	---	---	---	Mixed
KPS-CH-019	Ash, N barn cleanout	---	---	---	8671.80	Yes	Yes*	---	---	---	---	(Mixed)
KPS-CH-020A	Soil - E side N barn	0.50	(No)	---	6.37	No	No	66.8	Yes*	7.7	No	Landfill
KPS-CH-021	Soil, Backfill source	---	(No)	---	<5.20	No	No	8.7	No	5.1	No	NA
KPS-CH-022	Soil, Topsoil source	---	(No)	---	<4.30	No	No	5.0	No	4.1	No	NA
KPS-CH-023	Debris, N junk pile	---	No	Cr=0.022	---	(Yes)	(Yes)*	---	---	---	---	Rad
KPS-CH-024	Ash, N junk pile	---	No	Cr=0.027	120.00	Yes	Yes*	---	---	---	---	Rad
KPS-CH-025A	Ash/soil, E bound pit	0.50	(No)	---	<6.06	No	No	16.2	No	5.7	No	Clean
KPS-CH-025B	Ash/soil	1.00	(No)	---	<6.34	No	No	13.8	No	6.7	No	Clean
KPS-CH-026A	Ash/soil, N bound pit	0.50	(No)	---	<6.06	No	No	24.5	Yes*	3.4	No	Landfill
KPS-CH-026B	Ash/soil	1.00	(No)	---	<5.84	No	No	14.9	No	6.2	No	Clean
KPS-CH-027A	Ash/soil, W bound pit	0.50	(No)	---	<6.48	No	No	49.8	Yes*	2.3	No	Landfill
KPS-CH-027B	Ash/soil	1.00	(No)	---	<6.44	No	No	18.4	No	2.5	No	Clean
KPS-CH-027C	Ash/soil	1.50	(No)	---	<6.66	No	No	---	---	---	---	Clean
KPS-CH-028A	Ash/soil, SW bound pit	0.50	(No)	---	<5.88	No	No	14.5	No	2.4	No	Clean
KPS-CH-028B	Ash/soil	1.00	(No)	---	1.88	No	No	18.3	No	0.89	No	Clean
KPS-CH-029A	Ash/soil, SE bound pit	0.50	(No)	---	<5.74	No	No	10.7	No	2.0	No	Clean
KPS-CH-029B	Ash/soil	0.50	(No)	---	<6.32	No	No	14.2	No	2.8	No	Clean
KPS-CH-030A	Ash/soil, -029A dup	0.50	(No)	---	<6.56	No	No	---	---	---	---	Clean
KPS-CH-030B	Ash/soil, -029B dup	1.00	(No)	---	<6.18	No	No	---	---	---	---	Clean
KPS-CH-031	Runoff	---	---	---	5.65 mg/L	No	No	---	---	---	---	Clean
KPS-CH-032A1	Ash only, ash pit	0.25	Yes (Cr)*	6.54	1683.40	Yes	Yes*	---	---	---	---	Mixed
KPS-CH-032A2	Soil only, ash pit	0.50	No	Cr=0.026	15.20	Yes*	No	788	Yes*	2.6	No	(Rad)
KPS-CH-032B	Soil only, ash pit	1.00	---	---	3.86	No	No	202	Yes*	3.0	No	Landfill
KPS-CH-032C	Soil only, ash pit	1.50	(No)	---	<4.6	No	No	31.3	Yes*	6.6	No	Landfill
KPS-CH-032D	Soil only, ash pit	2.00	(No)	---	9.0	Yes	No	28.8	Yes*	9.5	No	(Landfill)
KPS-CH-032E	Soil only, ash pit	2.50	(No)	---	<4.4	No	No	18.9	No	4.7	No	Landfill

Kimble Characterization Samples

Sample ID	Matrix, Location	Depth (feet)	RCRA Fail? (a) >5mg/L	RCRA Fail? (a) Result	Total Uranium Result	Total Uranium >background?	Total Uranium >35 pCi/g?	Chromium Result	Chromium >20 mg/kg?	Arsenic Result	Arsenic >9.6 mg/kg?	Suggested Disposal (b)
KPS-CH-033A1	Ash only, ash pit	0.25	No	Cr=1.39	914.4	Yes	Yes*	---	---	---	---	(Mixed)
KPS-CH-033A2	Soil only, ash pit	0.50	No	Cr=0.200	18.52	Yes*	No	---	---	---	---	(Rad)
KPS-CH-034A	Soil beneath wood	0.50	---	---	41.4	Yes	Yes*	596	Yes	2.4	No	Rad
KPS-CH-034B	Soil beneath wood	1.00	(No)	---	4.54	No	No	43.6	Yes	4.0	No	Landfill
KPS-CH-035A1	Ash only, ash pit	0.25	No	Cr=2.22	1283.2	Yes	Yes*	---	---	---	---	(Mixed)
KPS-CH-035A2	Soil only, ash pit	0.50	No	Cr=0.124	12.76	Yes*	No	232	Yes*	2.4	No	(Rad)
KPS-CH-035B	Soil only, ash pit	1.00	---	---	<4.88	No	No	431	Yes*	4.0	No	Landfill
KPS-CH-035C	Soil only, ash pit	1.50	---	---	<4.2	No	No	326	Yes*	7.8	No	Landfill
KPS-CH-035D	Soil only, ash pit	2.00	---	---	7.68	No	No	136	Yes*	10.6	Yes*	Landfill
KPS-CH-035E	Soil only, ash pit	2.50	(No)	---	10.24	Yes	No	50.7	Yes*	10.2	Yes*	(Landfill)
KPS-CH-036A1	Ash only, ash pit	0.25	No	Cr=0.96	536.6	Yes	Yes*	---	---	---	---	(Mixed)
KPS-CH-036A2	Soil only, ash pit	0.50	(No)	---	11.5	Yes*	No	---	---	---	---	(Rad)
KPS-CH-037A	Soil downstream N junk	0.50	(No)	---	<5.2	No	No	17.3	No	5.1	No	Clean
KPS-CH-038A	Soil downstream N junk	0.50	(No)	---	5.4	No	No	23.6	No	4.9	No	Landfill
KPS-CH-039A	Boundary of wood stack	0.50	(No)	---	<4.2	No	No	32.7	Yes*	3.3	No	Landfill
KPS-CH-040A	Depth beneath wood	0.50	(No)	---	7.86	No	No	29.1	Yes*	2.2	No	Landfill
KPS-CH-040B	Depth beneath wood	1.00	(No)	---	<4.76	No	No	16.1	No	2.6	No	Clean
KPS-CH-040C	Depth beneath wood	1.50	(No)	---	5.96	No	No	23.1	Yes*	4.3	No	Landfill
KPS-CH-041	South junk pile	0.50	No	Cr=0.016	5.32	No	No	43.4	Yes*	5.2	No	Landfill
KPS-CH-042	South junk pile footprint	0.50	(No)	---	5.56	No	No	26.6	Yes*	4.0	No	Landfill
KPS-CH-043	Stove fire brick	---			---		---					
KPS-CH-044	Stove metal	---			---		---					

— Not analyzed

(a) Note regarding RCRA failure: (No) indicates that although TCLP-metals were not analyzed, data implies with a high degree of certainty that RCRA failure would not occur.

(b) NOTE REGARDING DISPOSAL OPTIONS:

Clean - If tot-U is above background concentrations and <35 pCi/g, and Cr and As concentrations are below the clean-up criteria, the material will be considered clean and left in place.

(Clean) - NOTE: Elevated concentration of Cr in KPS-CH-040C is likely due to slight cross-contamination and does not imply the presence of contamination in this layer of material.

(Rad) - If the tot-U concentration is greater than background, and Cr or As concentrations are above the criteria, the material must be considered part of the Rad waste stream, regardless of whether the rad concentration is less than the rad criterion.

Landfill - If tot-U is at background concentrations, the material may be disposed of at the landfill, regardless of the concentration of Cr or As (as long as RCRA limits are not exceeded).

(Landfill) - NOTE: Elevated Tot-U in KPS-CH-032D and KPS-CH-035E is likely due to slight cross-contamination and does not imply the presence of contamination in this layer of material.

Mixed - if the material exceeds the RCRA limit and is radioactive, the material is mixed waste to be treated at Envirocare

(Mixed) - ash-like material that is radioactive but did not necessarily fail RCRA, will be assumed hazardous due to the heterogeeous nature of the material in the ash pit

Yes* indicates the deciding factor in determining the waste disposal option

000030

000158

7536

Printed11/30/95

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000158

Bechtel

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151 Lafayette Drive
P.O. Box 350
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November 20, 1995

Mr. Chris Russell
Special Wastes Coordinator
Rumpke Waste Systems
10795 Hughes Road
Cincinatti, OH 45251

Dear Mr. Russell:

This letter transmits the proposed strategy for documentation of Kimble Property soils as non-radioactive prior to disposal at the Rumpke facility. You previously received a faxed draft copy of this memorandum and discussed and verbally approved it during a telephone conversation with our Environmental Technologist, Angela John. For formal documentation that you concur that our proposed strategy is sufficient to meet your needs, please sign the line below and return this letter to me at your earliest convenience.

If you have any questions or concerns, please contact me at (423) 576-1699 or Angela John at (423) 576-0410.

Sincerely,

A. J. Boos
Project Manager,
Kimble Property Remediation

Enclosures

Concurrence: Chris Russell
Chris Russell, Special Wastes Coordinator, Rumpke Waste Systems

cc: Dennis Riley, DOE-Fernald
Ed Skintik, DOE-Fernald

Bechtel National, Inc.

Background

BACKGROUND SAMPLING RESULTS FOR THE HAMILTON/OXFORD, OHIO AREA

Sample ID	Location	U-238 (pCi/g)	U-234 (pCi/g)	U-235 (pCi/g)	Tot-U (pCi/g)	Chromium (mg/kg)	Arsenic (mg/kg)
KPS-RA-002		0.79	0.47	0.03	1.29	x	x
KPS-RA-003		0.95	0.85	0.00	1.80	x	x
KPS-RA-004		0.75	0.98	0.02	1.75	x	x
KPS-RA-005		1.74	x	x	3.48	17.6	4.6
KPS-RA-006		4.55	x	x	9.10	17.8	5.6
KPS-RA-007		1.73	x	x	3.46	13.9	9.5
KPS-RA-008		0.94	x	x	1.88	15.0	5.0
KPS-RA-009		1.14	x	x	2.28	12.7	6.1
KPS-RA-010		1.60	x	x	3.20	12.1	4.4
Average					3.14	14.9	5.9
Max					9.10	17.8	9.5
Min					1.29	12.1	4.4
StdDev					2.38	2.4	1.9
Avg +2StdDev (BACKGROUND 95% CONFIDENCE):					**7.89**	**19.7**	**9.6**

x indicates analysis not conducted.

Note: Total Uranium (Tot-U) concentration is the sum of U-238, U-234, and U-235 concentrations for samples analyzed by alpha spectroscopy. For samples analyzed by gamma spectroscopy, total uranium is estimated by doubling the U-238 concentration, as is standard practice when uranium is in natural isotopic abundance.

Post-It™ brand fax transmittal memo 7671 | # of pages ▸ 5

To Ed Skintik Dennis Riley	From Angie John
Co. DOE-Fernald	Co.
Dept.	Phone # (423) 576-0410
Fax # (513) 648-3077	Fax # (423) 576-4898

ENCL 3

Bechtel

Oak Ridge Corporate Center
151 Lafayette Drive
P.O. Box 350
Oak Ridge, Tennessee 37831-0350

Facsimile: (615) 220-2100

December 20, 1995

7536

Mr. Dennis Riley
U. S. Department of Energy
Fernald Area Office
P.O. Box 538705
Cincinnati, OH 45253-8705

Attention: Mr. Dennis Riley

Subject: On-site Background Conditions at the Kimble Property Site

Dear Mr. Riley:

This letter documents the rationale for a proposed increase in the site clean-up criterion for arsenic, as discussed in your December 19 telecon with Dave Freas, Angie John, and Joe Wood. The current criterion, 9.6 mg/kg (ppm), was evaluated during characterization and was deemed equivalent to off-site background; however, recent sampling indicates that on-site background is substantially higher than the criterion.

Selection of On-site Background Locations

To evaluate the pre-existing conditions on the Kimble property, four locations were selected that would reflect conditions existing at the site prior to receipt of Fernald materials. These locations, which are shown on the attached figure, are situated along the eastern half of the property. Locations were selected based on remoteness from current or suspected past contact with Fernald-originating materials. Measurements of beta-gamma radioactivity in the areas indicate no radioactive contamination. Gamma spectroscopy analytical results for surface soil samples collected at each location indicate only background concentrations of uranium (Table 1).

Site stormwater runoff drains generally to the ditches along the center line of the property on the northern parcel and to the stream bed on the western edge of the southern parcel; therefore, topography limits the potential for surface runoff on the western portion of the site to reach the eastern portions of

the site. Inasmuch as the ash material and the great majority of the wood storage occurred on the western half of the property, the eastern portion was deemed the appropriate region for determination of on-site background conditions.

Samples were collected at 6" intervals at each location until a depth of 3' was achieved or refusal was reached, whichever occurred first. The sampling locations on the southern parcel of the property (KPS-CH-046, KPS-CH-047) are both in a field that has been used for livestock. Sampling location KPS-CH-048 is in the lawn area of the property, away from any redwood constructions. Sampling location KPS-CH-049 was the most physically distant location, situated in the densely forested area on the northeast corner of the property. The remoteness of this location makes it an area that is unlikely to have been used for any kind of ash disposal or redwood structure installation.

On-site Background Sampling Results

Sampling results for the four on-site background locations are presented on the figure and in the attached table. Evaluation of the arsenic results for these samples indicate that in on-site areas believed to be completely unaffected by Fernald-originating materials, arsenic concentrations may be expected to be as high as 19.2 mg/kg (with 95% confidence). Uniformly, arsenic concentrations in these areas exceed the current cleanup criterion.

These concentrations are likely to be naturally occurring. The United States Geological Survey professional paper 1270 "Element Concentrations in Soils and Other Surficial Materials of the Conterminous United States" (Shacklette and Boerngen, 1984) describes concentrations of metals in generally undisturbed soils throughout the country. Background arsenic concentrations in Southern Ohio were found ranging from 10 to 65 ppm, in keeping with the concentrations found on the Kimble property.

Recommendation for Increasing the Arsenic Criterion

Based on the arsenic results for samples collected from areas on-site that were not affected by Fernald-originating materials, there is strong evidence that on-site background exceeds the current cleanup guideline for the metal, rendering the current criterion an unattainable goal. The criterion was adopted from the Record of Decision for Fernald's Operating Unit 5. The additional sampling described above indicates that this concentration is not consistent with on-site background at the Kimble property. To remediate the property of Fernald-originating material, we recommend that the criterion for arsenic be increased to **20 mg/kg**, consistent with on-site, pre-existing conditions.

7536

There is no inhalation hazard for arsenic at a 20 mg/kg concentration. Based on a conservative assumption of a dust level of 5 mg/m^3 for dusty activities such as construction, the corresponding calculated airborne arsenic concentration would be 1×10^{-4} mg/m^3, which is more than three orders of magnitude smaller than the OSHA exposure limit of 0.5 mg/m^3. In addition, remediation of the Kimble property entails excavation of soils followed by backfilling with clean fill; concentrations of arsenic in the 10 - 20 mg/kg range will be subsurface (i.e. 18" to 4' below grade), making access to the soils extremely unlikely.

Please contact Dave Freas at (423) 220-2221 or myself at (423) 576-1699, should you have any questions on this matter.

Sincerely,

FOR A. J. Boos
Project Manager,
Kimble Property Remediation

Concurrence: A. K John @ _____
J. G. Wood _____

AKJ/akj

Enclosures

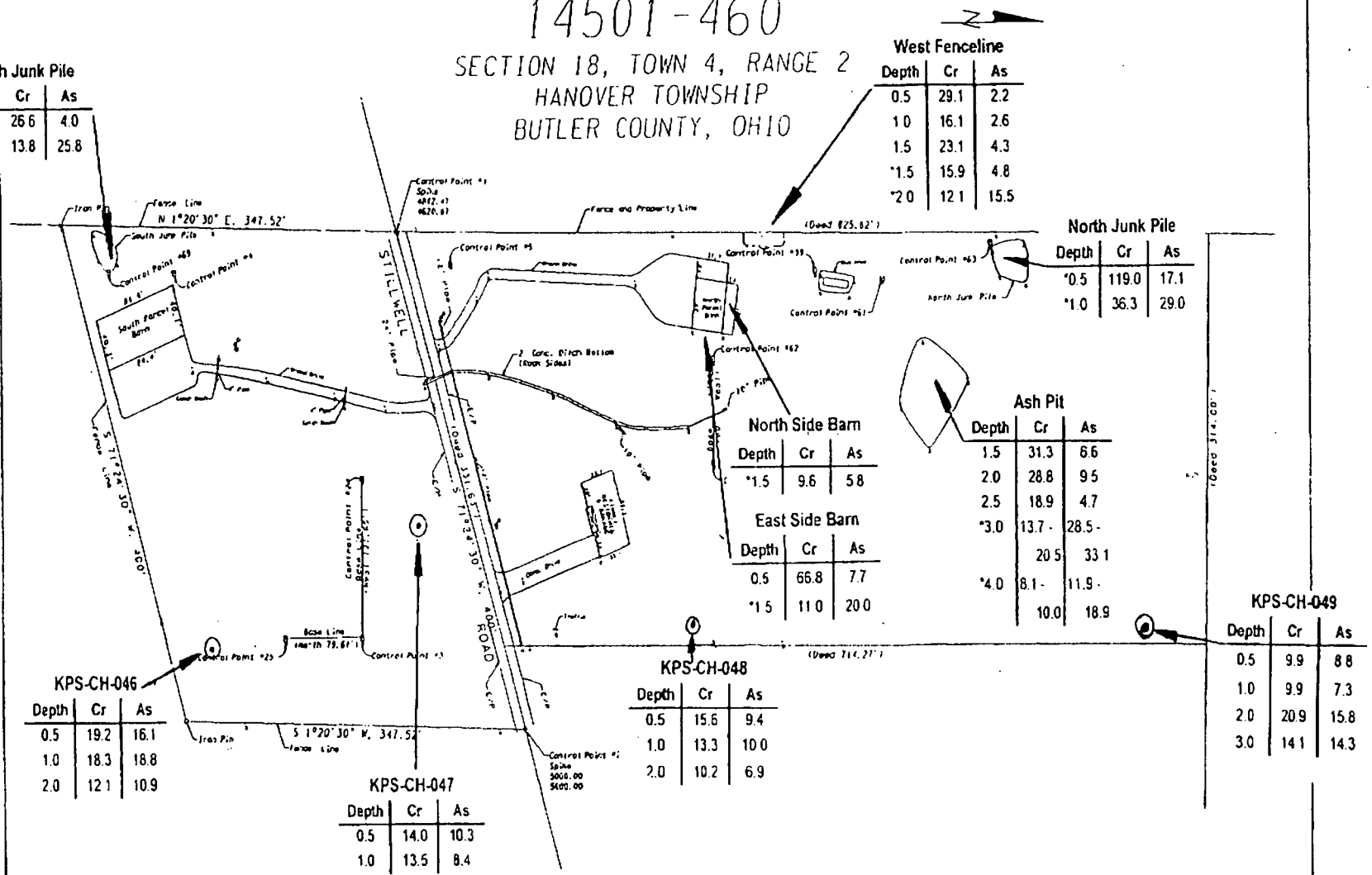
cc: E. Skintik w/attachment

TABLE 1: ON-SITE BACKGROUND SAMPLING RESULTS FOR THE KIMBLE SITE

Sample ID	Location	Depth	U-238 (pCi/g)	Total U (pCi/g)		Chromium (mg/kg)	Arsenic (mg/kg)
KPS-CH-046A	N 146, E 279	0.5	1.5	3.00	MDA	19.2	16.1
KPS-CH-046B		1.0				18.3	18.8
KPS-CH-046D		2.0				12.1	10.9
KPS-CH-047A	N 314, E 190	0.5	1.7	3.40	MDA	14.0	10.3
KPS-CH-047B		1.0				13.5	8.4
KPS-CH-048A	N 551, E 266	0.5	1.8	3.60	MDA	15.6	9.4
KPS-CH-048B		1.0				13.3	10.0
KPS-CH-048D		1.5				10.2	6.9
KPS-CH-049A	N 1070, E 260	0.5	1.8	3.60	MDA	9.9	8.8
KPS-CH-049B		1.0				9.9	7.3
KPS-CH-049D		2.0				20.9	15.8
KPS-CH-049F		3.0				14.1	14.3
					Average	14.3	11.4
					Standard Deviation	3.7	3.9
					Avg – 2 sigma	21.6	19.2

SITE SURVEY
KIMBLE PROPERTY
14501-460

SECTION 18, TOWN 4, RANGE 2
HANOVER TOWNSHIP
BUTLER COUNTY, OHIO



South Junk Pile

Depth	Cr	As
*0.5	26.6	4.0
*1.0	13.8	25.8

West Fenceline

Depth	Cr	As
0.5	29.1	2.2
1.0	16.1	2.6
1.5	23.1	4.3
*1.5	15.9	4.8
*2.0	12.1	15.5

North Junk Pile

Depth	Cr	As
*0.5	119.0	17.1
*1.0	36.3	29.0

North Side Barn

Depth	Cr	As
*1.5	9.6	5.8

East Side Barn

Depth	Cr	As
0.5	66.8	7.7
*1.5	11.0	20.0

Ash Pit

Depth	Cr	As
1.5	31.3	6.6
2.0	28.8	9.5
2.5	18.9	4.7
*3.0	13.7 - 20.5	28.5 - 33.1
*4.0	8.1 - 10.0	11.9 - 18.9

KPS-CH-046

Depth	Cr	As
0.5	19.2	16.1
1.0	18.3	18.8
2.0	12.1	10.9

KPS-CH-047

Depth	Cr	As
0.5	14.0	10.3
1.0	13.5	8.4

KPS-CH-048

Depth	Cr	As
0.5	15.6	9.4
1.0	13.3	10.0
2.0	10.2	6.9

KPS-CH-049

Depth	Cr	As
0.5	9.9	8.8
1.0	9.9	7.3
2.0	20.9	15.8
3.0	14.1	14.3

Concentrations are in mg/kg (ppm); depths are in feet

BROSEY SURVEYING COMPANY
4045 STILLWELL ROAD
HAMILTON, OHIO 45013

SEPT. 26, 1995

0 40 80
SCALE IN FEET

* - Indicates sample was a post-RA composite over the remediated area

(•) Indicates sampling location was selected to determine on-site background

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Bechtel

Oak Ridge Corporate Center
151 Lafayette Drive
P.O. Box 350
Oak Ridge, Tennessee 37831-0350

Facsimile: (615) 220-2100

January 8, 1996

Ohio Environmental Protection Agency
Division of Hazardous Waste Management
401 E. 5th Street
Dayton, OH 45402-2911

Attention: Mr. Chris Budich

Subject: KIMBLE PROPERTY CHARACTERIZATION SAMPLES

Dear Mr. Budich:

As per your request, Bechtel is providing to you a technical description of the subsurface soil sampled to identify the onsite background concentrations of arsenic and chromium at the Kimble property in Butler County, Ohio. Photographs of the soil profile at each sample location are also provided for review

This submittal consists of an internal report memo that defines general soil conditions in Butler County as developed by the U.S. Department of Agriculture and Soil Conservation Service and a description of the soil at each sample location. An appropriate soil map, site sketch, and survey document are provided as supportive information along with the photographs. From this information, it is Bechtel's belief that the onsite characterization samples taken at the Kimble property are representative of typical soil conditions in this region and have not been altered by backfill or disposal events.

If there are any questions pertaining to this information, please call Angela John at (423) 576-0410.

Very truly yours,

A. J. Boos
Project Manager

AJB/DF/ayi o:\work\misc\budich ltr

Attachments 1 Internal Report Memo with following items

- Site Sketch
- Soil Maps
- Photograph Listing
- Soil Survey of Butler County Ohio
- Photographs

Bechtel National, Inc.

7536

Bechtel

Interoffice Memorandum

To	D. Freas	File No.	
Subject	Soil Description of Test Pits at Kimble Property Site, Butler County, Ohio Bechtel Project No. 14501-460	Date	January 5, 1996
		From	M.A. Gage
		Of	G & HES
Copies To	K. Skinner R. Boutin	At	ORO Ext 2544

At your request I have completed a review of photographs and provided soil descriptions for four soil test locations at the above referenced site. The test excavations were conducted January 3, 1996. Depth of investigation ranged from 18 to 36 inches below ground surface. To assist in my description, I conducted a literature search for a characterization of the soils in Butler County. Referenced is the "Soil Survey of Butler Co., Ohio", developed by the U S Department of Agriculture and Soil Conservation Service, January 1980 Excerpts from this reference are attached. Below are a general description of the soils from the literature and descriptions of soils exposed during the excavations. My descriptions are based on information from the literature and the excavation photographs you provided. Figure 1 shows the test locations. Figure 2 is from the literature and shows the soil series present at the site.

General Description From "Soil Survey of Butler County, Ohio"

Site Location: Section 18, Township 4N, Range 2 E., Hanover Township, Butler Co. Ohio.(Figure 2)

Soils at the test areas are grouped into the Wynn and Xenia series. These series consist of deep to moderately deep, well drained soils present on glacial till plains and uplands. Soil thickness ranges from approximately 30 to 60 inches. They are formed in a layer of loess, in glacial till, and the underlying calcareous shale and limestone bedrock. Soils have moderately slow to slow permeability, and moderate to low water capacity Reaction ranges from strongly acidic(5.1 to 5.5) to mildly alkaline (7.4 to 7.8) in the rooting zone. Support data including descriptions, tables of engineering, physical and chemical properties, and soil and water features are attached.

Soil Test Descriptions

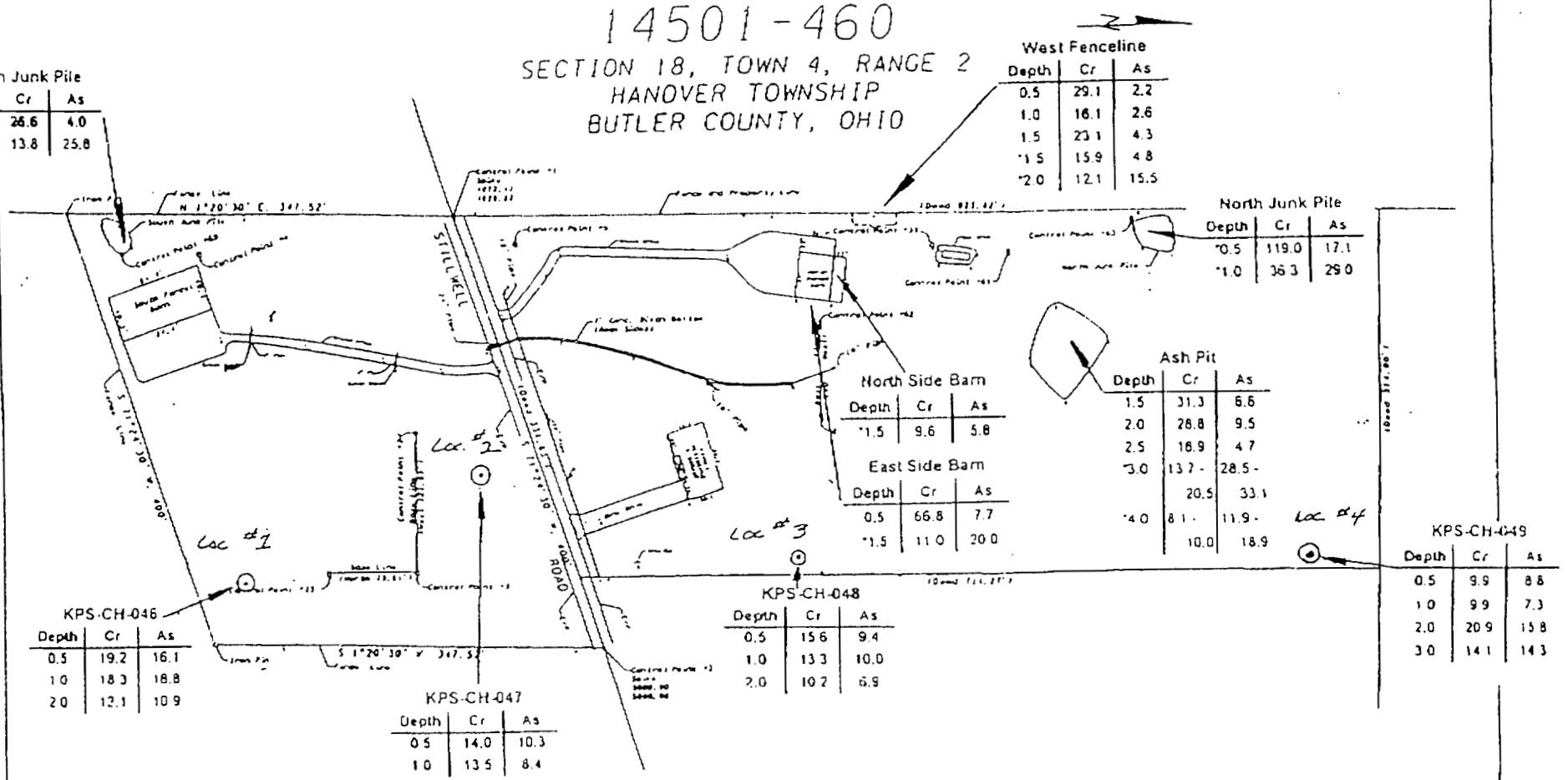
Test Location	Soil Description
KPS-CH-046 (loc 1)	0 to 6 inches; dark yellowish orange (10YR 6/6) silt loam (ML-CL), friable, with abundant roots and organic plant material. 6 to 24 inches; dark yellowish brown (10YR 4/2) silty clay loam (CL), firm, with some well rounded gravel and pebbles. 24 to 30 inches; grayish brown (5YR 3/2) silty clay loam (CL), firm, with some well rounded gravel and pebbles.
KSP-CH-047 (loc. 2)	0 to 6 inches; dark yellowish orange (10YR 6/6) silt loam (ML-CL), friable, with abundant roots and organic plant material. 6 to 12 inches, dark yellowish orange (10YR 6/6) silty clay loam (CL), firm, with some well rounded gravel and pebbles. 12 to 18 inches, dark yellowish brown (10YR 4/2) silty clay loam (CL), firm, with some well rounded gravel and pebbles.
KSP-CH-048 (loc 3)	0 to 8 inches; olive gray (5Y 3/2) silt loam (ML-CL), friable, with abundant roots and organic plant material. 8 to 24 inches; light olive gray (5Y 5/2) silty clay loam (CL), firm, with some well rounded gravel and pebbles
KSP-CH-049 (loc. 4)	0 to 6 inches; light olive gray (5YR 5/2) silt loam (ML-CL), friable, with abundant roots and organic plant material. 6 to 18 inches; light olive brown (5Y 5/6) silty clay loam (CL), firm, little plant roots, with some well rounded gravel and pebbles. 18 to 36 inches; olive gray (5Y 3/2) silty clay loam (CL), firm, trace plant roots, with some well rounded gravel and pebbles.

It has been a pleasure to support you on this task Please advise if you have any question or need additional information

Attachment

SITE SURVEY
KIMBLE PROPERTY
14501-460

SECTION 18, TOWN 4, RANGE 2
HANOVER TOWNSHIP
BUTLER COUNTY, OHIO



South Junk Pile

Depth	Cr	As
*0.5	26.6	4.0
*1.0	13.8	25.8

West Fenceline

Depth	Cr	As
0.5	29.1	2.2
1.0	16.1	2.6
1.5	23.1	4.3
*1.5	15.9	4.8
*2.0	12.1	15.5

North Junk Pile

Depth	Cr	As
*0.5	119.0	17.1
*1.0	36.3	29.0

North Side Barn

Depth	Cr	As
*1.5	9.6	5.8

East Side Barn

Depth	Cr	As
0.5	66.8	7.7
*1.5	11.0	20.0

Ash Pit

Depth	Cr	As
1.5	31.3	6.6
2.0	28.8	9.5
2.5	16.9	4.7
*3.0	13.7 -	28.5 -
	20.5	33.1
*4.0	8.1 -	11.9 -
	10.0	18.9

KPS-CH-046

Depth	Cr	As
0.5	19.2	16.1
1.0	18.3	18.8
2.0	12.1	10.9

KPS-CH-047

Depth	Cr	As
0.5	14.0	10.3
1.0	13.5	8.4

KPS-CH-048

Depth	Cr	As
0.5	15.6	9.4
1.0	13.3	10.0
2.0	10.2	6.9

KPS-CH-049

Depth	Cr	As
0.5	9.9	8.8
1.0	9.9	7.3
2.0	20.9	15.8
3.0	14.1	14.3

Concentrations are in mg/kg (ppm); depths are in feet

SCALE IN FEET

SEPT. 26, 1995

BROSET SURVEYING COMPANY
4045 STILLWELL ROAD
HAMILTON, OHIO 45013

* - Indicates sample was a post-RA composite over the remediated area

⊙ - Indicates sampling location was selected to determine on-site background

SHEET NUMBER 35

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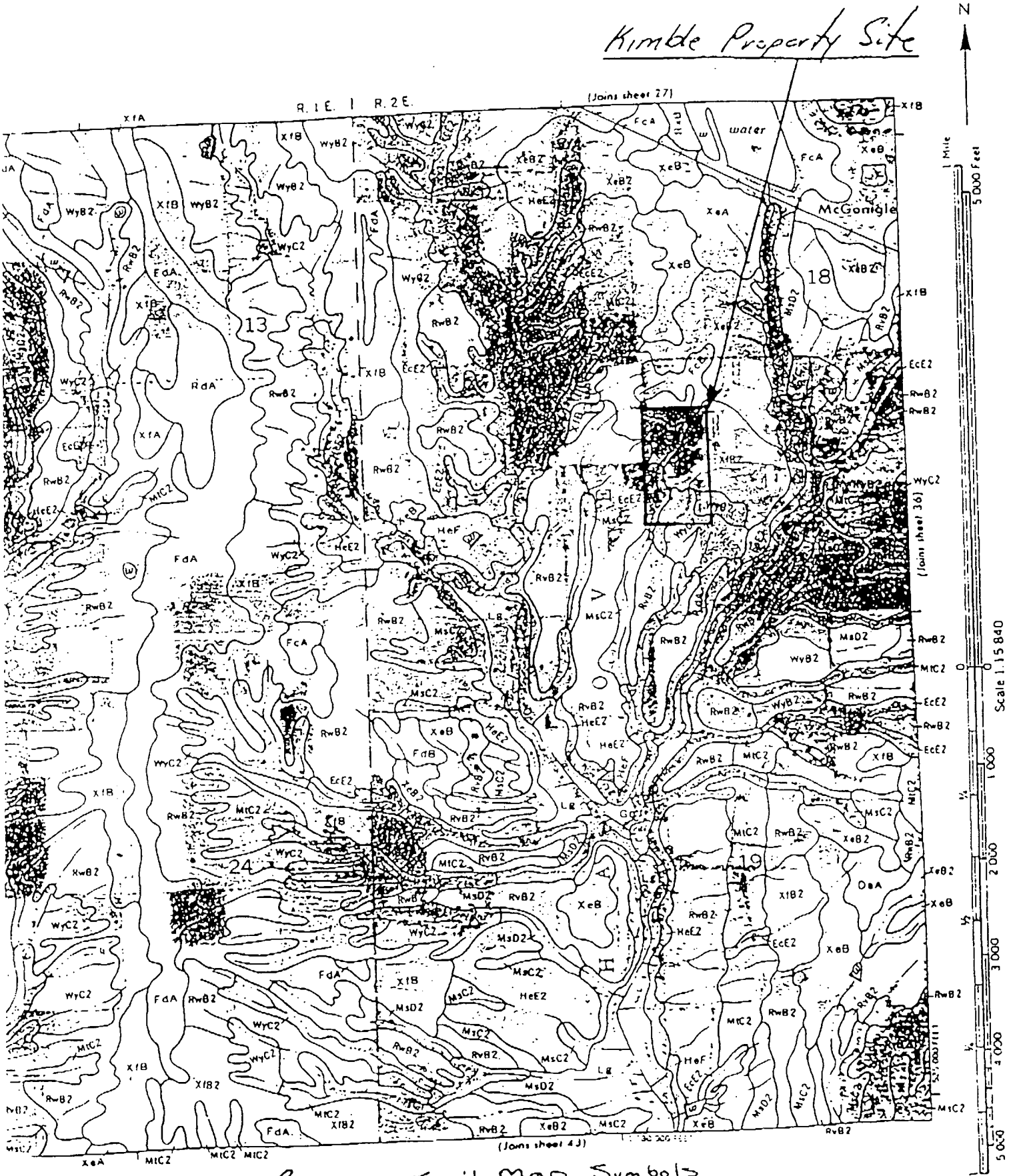

Soil Map Symbols

XfB2
WyC2

Source: Soil Survey of Butler Co. US Dept. of Agriculture Soil Conservation Svc. Jan 1980

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FIGURE 2

Govt.
USDA/SS-OH-
8001-1

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Soil Survey of

BECHTEL - OAK RIDGE
LIBRARY
REC'D JUN 20 1985

BUTLER COUNTY, OHIO

United States Department of Agriculture
Soil Conservation Service
in cooperation with
Ohio Department of Natural Resources
Division of Lands and Soils, and
Ohio Agricultural Research and Development Cen

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inches, makes excavation difficult and expensive; however, the bedrock is rippable by heavy equipment and rarely requires blasting. The many flagstones are undesirable in a pond embankment. Ground water flowing on the surface of the nearly impervious shale will cause wet-weather seeps on some slopes and in waterways. Water can also seep into excavations if not intercepted and drained off. This is common on the lower parts of slopes and foot slopes of hills. Low strength and potential frost action are limitations for local roads but can be overcome by using suitable base material.

This soil is in capability subclass IIe; woodland suitability subclass 2o.

WyB2—Wynn silt loam, 2 to 6 percent slopes, moderately eroded. This gently sloping, moderately deep, well drained soil is on rims of high, upland ridges and crests and on hillsides where the glacial till is thin over shale and limestone bedrock. Most areas are elongated in shape and range from 3 to 100 acres in size. Many larger areas are dissected by shallow waterways. Most areas, especially those surrounding the waterways, are moderately eroded. Many areas have common, flat limestone flagstones and igneous pebbles lying on the surface, especially on slope breaks. Slopes are quite long in some areas. Depth to bedrock ranges from 20 to 40 inches.

Typically, the surface layer is brown, friable silt loam about 8 inches thick. The subsoil is about 22 inches thick. The upper part is dark yellowish brown and brown, firm silty clay loam; the middle part is dark reddish brown, firm clay with about 10 percent stone fragments; and the lower part is dark reddish brown clay and light olive brown, firm clay with about 10 percent stone fragments. The substratum, to a depth of about 33 inches, is olive brown clay and dark reddish brown, firm clay and heavy clay loam that is calcareous. Below 33 inches it is olive brown, calcareous clay shale interbedded with dark gray, thin-bedded strata of fossiliferous limestone of Ordovician age.

Included with this soil in mapping are small areas, generally less than 2 acres in size, of moderately well drained, nearly level soils that have some gray mottling in the subsoil. Also included are small areas of Russell-Miamian, bedrock substratum, soils on the lower part of slopes. They are deeper than 40 inches to bedrock and have a layer of stony till over shale and limestone. In addition, there are many, small, reddish brown or olive brown eroded spots that are sticky when wet and cloddy when dry because the clayey subsoil has been exposed by erosion. Small areas of Dana silt loam, bedrock substratum, soils are inclusions in some areas. They have a darker surface layer and greater depth to bedrock. These inclusions make up about 15 percent of some of the high areas.

In this Wynn soil, permeability is moderately slow to slow, and available water capacity is low. Runoff is medium. Reaction ranges from strongly acid to neutral in the subsoil, and varies widely in the surface layer as a result of past liming practices. The organic-matter content is low as a result of the loss of surface soil by erosion. The surface layer tends to crust or puddle after a hard rain. Root development is restricted by the shale and limestone bedrock.

Most areas of this soil are farmed. Potential is medium for cultivated crops, hay, pasture, and trees. It is low for building site development and sanitary facilities.

This soil is suited to cultivated crops, small grain, and grasses and legumes for hay and pasture. If the soil is used for cultivated crops, there is a hazard of further erosion. The control of erosion, maintenance of good tilth, and increase of organic matter are important to good management. No-till or minimum tillage, using crop residues, winter cover crops and grassed waterways, reduces erosion and helps maintain the organic-matter content of the soil. In many areas, slopes are long enough and smooth enough to be terraced and farmed on the contour. Returning crop residues to the soil or the regular addition of other organic material helps to improve fertility, reduce crusting, and increase water infiltration. The soil tends to become droughty in summer and fall because of the limited depth to bedrock.

The use of this soil for pasture or hay is also effective in controlling erosion. Grazing when the soil is too wet, however, will cause surface compaction, excessive runoff, and poor tilth. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and soil in good condition.

This soil is suited to trees, and some areas remain in hardwoods. Tree seeds, cuttings, and seedlings survive and grow well if competing vegetation is controlled or removed by site preparation and by spraying, cutting, or girdling. There are few soil limitations that affect planting or harvesting trees. Tree seedlings are machine planted on this soil.

This soil has limitations for building site development and for sanitary facilities. The interbedded shale and limestone bedrock, at a depth of 20 to 40 inches, make excavations difficult and expensive; however, the bedrock is rippable by heavy equipment and rarely requires blasting. The many flagstones in this soil make it undesirable for use in pond embankments. Ground water flowing on the surface of the nearly impervious shale causes wet weather seeps on some slopes and in waterways. Water can seep into excavations if not intercepted and drained off. This is common on the lower parts of slopes and foot slopes of hills. Low strength and potential frost action are limitations for local roads but can be overcome by using suitable base material.

This soil is in capability subclass IIe; woodland suitability subclass 2o.

WyC2—Wynn silt loam, 6 to 12 percent slopes, moderately eroded. This moderately sloping, moderately deep, well drained soil is on sides and crests of high, upland ridges and hills where the glacial till is thin over shale and limestone bedrock. Many areas are crescent

aped belts around rather large waterways, between e higher ridgetop divides and the steep soils immedi- ely adjacent to the waterway. Individual areas range om 3 to 120 acres in size. Most areas are dissected by aterways, and, especially around the waterways, are oderately eroded. Slopes are quite long in some areas. epth to bedrock is 20 to 40 inches. Many areas have ommon flagstones and igneous pebbles on the surface, specially on slope breaks in cultivated fields and in and ound waterways.

Typically, the surface layer is brown, friable silt loam bout 8 inches thick. The subsoil is about 21 inches ick. The upper part is dark yellowish brown and brown, rm silty clay loam; the middle part is dark reddish rown, firm clay with about 10 percent stone fragments; nd the lower part is dark reddish brown clay intermin- led with light olive brown firm clay. The substratum, to a epth of about 33 inches, is calcareous, olive brown clay nd dark reddish brown, firm clay and heavy clay loam. elow 33 inches, olive brown, calcareous clay shale is nterbedded with dark gray, thin-bedded strata of fossili- erous limestone bedrock.

Included with this soil in mapping are small areas of Eden soils. Wynn soils have a component of till in the ubsoil, and Eden soils do not. Also included are small reas of Miamian-Russell, bedrock substratum, soils. They are deeper to bedrock than Wynn soils, and gener- ally have a layer of stony till over the bedrock. Also ncluded are small areas where the soil is severely roded. These show up on the landscape as olive rown, "eroded" spots. They are sticky when wet and loddy when dry because the weathered clayey shale is xposed. These areas are generally less than 24 inches o interbedded shale and limestone. Small areas of Dana ilt loam, bedrock substratum, soils are inclusions in ome places. They have a darker surface layer and are eeper to bedrock than Wynn soils. These included soils nake up about 20 percent of some of the larger areas.

In this Wynn soil permeability is moderately slow to low, and available water capacity is low. Runoff is rapid. Reaction ranges from strongly acid to neutral in the subsoil and varies widely in the surface layer as a result of local liming practices. The organic-matter content is ow as a result of the loss of surface soil by erosion. The urface layer tends to crust or puddle after a hard rain. Root development is restricted by the shale and lime- tone bedrock.

While many areas of this soil are farmed, about an equal acreage is in pasture or trees. The soil has medium potential for growing cultivated crops, hay, pas- ure, and trees. It has low potential for building site evelopment and sanitary facilities because of slope and imited depth to bedrock.

This soil is suited to cultivated crops, small grain, and grasses and legumes for hay and pasture. If the soil is used for cultivated crops, there is a severe hazard of urther erosion. The control of erosion, maintenance of good tilth, and increase of organic matter are important o good management. No-till or minimum tillage using crop residues, winter cover crops, and grassed water- ways reduces erosion and helps maintain the organic- matter content of the soil. Many slopes are long enough and smooth enough to be stripcropped or terraced and farmed on the contour. Returning crop residues to the soil or the regular addition of other organic material helps to improve fertility, prevent crusting, and increase water infiltration. This soil tends to become droughty in summer and fall because of limited depth to bedrock and rapid runoff.

The use of this soil for pasture or hay is also very effective in controlling erosion. Grazing when the soil is too wet, however, will cause surface compaction, exces- sive runoff, and poor tilth. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and soil in good condition.

This soil is suited to trees, and some areas remain in hardwoods. Tree seeds, cuttings, and seedlings survive and grow well if competing vegetation is controlled or removed by site preparation and by spraying, cutting, or girdling. There are few soil limitations that affect planting or harvesting trees. Tree seedlings are machine planted on this soil.

This soil has limitations for building site development and for sanitary facilities. The interbedded shale and limestone bedrock underlying this soil, at a depth of 20 to 40 inches, make excavation difficult and expensive; however, the bedrock is rippable by heavy equipment and rarely requires blasting. The many flagstones are undesirable in a pond embankment. Ground water flow- ing on the surface of the nearly impervious shale causes wet weather seeps on some slopes and in waterways. Water can also seep into excavations if not intercepted and drained off. This is common on the lower parts of slopes and foot slopes of hills. Low strength and poten- tial frost action are limitations for local roads, but can be overcome by using suitable base material.

This soil is in capability subclass IIIe; woodland suit- ability subclass 2o.

WzC3—Wynn silty clay loam, 6 to 12 percent slopes, severely eroded. This moderately sloping, mod- erately deep, well drained soil is on knobs, on the upper part of the long side slopes, and on side slopes that receive surface runoff from higher areas. Some fan shaped areas are on hillsides where the glacial till is only a thin smear over shale and limestone bedrock. Most areas have been cultivated up and down the hill and have become dissected by shallow gullies and water- ways because of very rapid surface runoff. These areas are now severely eroded and are characterized by a clayey, olive brown surface layer containing common, flat limestone flagstones and igneous glacial pebbles. Indi- vidual areas range from 5 to 20 acres. Slopes are com- monly short and abrupt.

Typically, the surface layer is olive brown, firm silty clay loam about 5 inches thick. The subsoil is about 15

opment and low for sanitary facilities. Potential is medium to high for most recreational development.

The erosion hazard is moderate. Minimum tillage, winter cover crops, and grassed waterways can prevent excessive soil loss. The soil's natural drainage generally is adequate for farming, but most crops will be benefited if random subsurface lines are installed to drain wet spots. In some areas, lime applications are required to maintain proper reaction in the rooting zone. The surface layer crusts after rain, but the regular addition of organic matter reduces crusting and improves fertility. Maintenance to control erosion and soil fertility and organic-matter levels is the main management concern.

Using this soil for pasture or hay is effective in controlling erosion. Grazing when the soil is wet, however, can cause surface compaction, excessive runoff, and poor tilth. Proper stocking rates, pasture rotation, and restricted use during wet periods help to keep the pasture and the soil in good condition.

This soil is well suited to trees. Plant competition is a moderate limitation, but tree seeds and seedlings survive and grow well if the competing vegetation is controlled. There are no other limitations for planting or harvesting trees.

The moderately slow permeability and seasonal high water table limit use of the soil for septic tank absorption fields. The seasonal high water table and depth to bedrock limit shallow excavations. The soil's wetness, low strength, and seasonal high water table limit its use for small commercial buildings. The seasonal high water table is also a limitation for homes with basements. High frost action potential and low strength are limitations for local roads, which can be overcome by using a suitable base material.

The stony till or bedrock in the substratum of this soil makes all excavation difficult and expensive. It is rippable, however, by heavy equipment and rarely requires blasting. The many flagstones in the till make it undesirable for pond embankment. Water flowing over the bedrock can seep into excavations if it is not intercepted and diverted.

This soil is in capability subclass IIe; woodland suitability subclass 1o.

XfB2—Xenia silt loam, bedrock substratum, 2 to 6 percent slopes, moderately eroded. This deep, gently sloping, moderately well drained soil is on bedrock-controlled till plains. Most areas are circular or irregular in shape and 2 to 200 acres.

Typically, the surface layer is dark grayish brown, friable silt loam about 7 inches thick. The subsoil is 29 inches thick. The upper part is firm, brown silty clay loam; the middle part is firm, dark yellowish brown silty clay loam that has grayish brown mottles; and the lower part is firm, dark yellowish brown clay loam with grayish brown mottles. The substratum, to a depth of 50 inches, is dark yellowish brown stony clay loam that is 15 to 30 percent limestone flagstones. Interbedded shale ar limestone bedrock of Ordovician age is at a depth of 5 inches. The bedrock is at a depth of 48 to 72 inches. is more than 66 percent soft clay shale and less than 3 percent crystaline, fossiliferous, thin-bedded limeston

Included with this soil in mapping are small areas the somewhat poorly drained Fincastle, bedrock substratum, soils, the well drained Russell-Miamian, bedroc substratum, soils, and the well drained Wynn soils. Th Fincastle soils are grayer in the subsoil than this Xeni soil and are in low areas, usually at the head of wate ways and in shallow basins. The Russell-Miamian soil are less gray in the subsoil and are on the upper part the slopes, generally near the crest and shoulder. Th Wynn soils are also less gray in the subsoil but hav bedrock 20 to 40 inches below the surface. Also incluc ed are some areas that are deeper than 72 inches t bedrock.

This soil has moderately slow permeability, moderat available water capacity, and medium runoff. The surfac layer is low in organic-matter content, and tilth is gooc Reaction is medium acid to mildly alkaline in the rootin zone. The water table is perched over the subsoil i spring.

This soil has high potential for cultivated crops, an most areas are used as cropland. Corn, soybeans wheat, and hay are the major crops. This soil also ha high potential for pasture and woodland and for wildlif habitat. Potential is medium for building site developmen and low for sanitary facilities. Potential is medium to higl for most recreational development.

The erosion hazard is moderate. Minimum tillage winter cover crops, and grassed waterways prevent ex cessive soil loss. Natural drainage of the soil generally i adequate for farming, but installing random subsurface lines to drain wet spots will benefit most crops. In some areas of this soil, lime applications are required to maintain proper reaction in the rooting zone. The surface layer crusts after rain, but the addition of organic matter reduces crusting and improves soil fertility. Maintenance to control erosion and soil fertility and organic-matter levels is the main management concern.

Using this soil for pasture or hay is effective in controlling erosion. Grazing when the soil is wet, however, can cause surface compaction, excessive runoff, and poor tilth. Proper stocking, pasture rotation, and restricted use during wet periods help keep the pasture and the soil in good condition.

This soil is well suited to trees. Plant competition is a moderate limitation, but tree seeds and seedlings survive and grow well if the competing vegetation is controlled. There are no other limitations for planting or harvesting trees.

Moderately slow permeability and a seasonal high water table limits use of this soil for septic tank absorption fields. The high water table and depth to bedrock are also limitations for shallow excavations. Soil wet-

moderately alkaline. In some pedons, a strongly illuviated horizon of clay and organic matter is at the contact of the calcareous sand and gravel. It normally has a darker color than the overlying B horizon. The dolomite pebbles in this layer show evidence of weathering.

The underlying C horizon ranges considerably in proportion of sand and gravel and in the degree of stratification.

Wea series

The Wea series consists of deep, well drained soils on glacial outwash terraces and plains. These soils formed in a mantle of loess in the underlying loamy outwash over sand and gravel. Slope is 0 to 6 percent.

These soils have a higher silt content than is defined as the range for the Wea series, but this difference does not materially effect their use or management.

Wea soils are similar to Tippecanoe soils and commonly are adjacent to Ockley, Tippecanoe, and Warsaw soils. Tippecanoe soils have 2-chroma mottles in the upper 75 centimeters of the argillic horizon. Ockley soils have a ochric epipedon and are in a fine-loamy family. Warsaw soils are in a fine-loamy family and have a solum that is less than 40 inches thick.

Typical pedon of Wea silt loam, 0 to 2 percent slopes, about 0.5 mile southwest of Symmes Corner, Fairfield Township, R. 2, T. 1, section 3, from northeast corner, 1,315 feet south and 1,980 feet west:

Ap—0 to 9 inches; very dark grayish brown (10YR 3/2) silt loam, dark brown (10YR 3/3) rubbed; weak fine granular structure; friable; medium acid; abrupt smooth boundary.

A12—9 to 14 inches; very dark grayish brown (10YR 3/2) silt loam, dark brown (10YR 3/3) rubbed; moderate fine and medium subangular blocky structure; friable; slightly acid; clear wavy boundary.

B1—14 to 19 inches; dark yellowish brown (10YR 4/4) dark brown (10YR 3/3) heavy silt loam; moderate fine and medium subangular blocky structure; friable; slightly acid; clear smooth boundary.

B21t—19 to 25 inches; dark yellowish brown (10YR 4/4) silty clay loam; dark brown (10YR 3/3) organic coatings on faces of peds; moderate medium subangular blocky structure; firm; thin patchy clay films on faces of peds; slightly acid; clear wavy boundary.

B22t—25 to 30 inches; dark yellowish brown (10YR 4/4) silty clay loam; strong medium subangular blocky structure; firm; thin patchy dark brown (10YR 3/3) clay films on vertical and horizontal faces of peds; slightly acid; clear wavy boundary.

B23t—30 to 35 inches; dark yellowish brown (10YR 4/4) silty clay loam; strong medium subangular blocky structure; firm; thin patchy dark brown (10YR 3/3) clay films on vertical and horizontal faces of peds; slightly acid; clear wavy boundary.

IIB24t—35 to 41 inches; dark yellowish brown (10YR 4/4) clay loam; moderate medium and coarse subangular blocky structure; firm; thin patchy brown (10YR 4/3) clay films on vertical faces of peds; 2 percent rounded, 2 to 5 millimeter pebbles; 2 percent white chert fragments; slightly acid; clear wavy boundary.

IIB25t—41 to 48 inches; dark yellowish brown (10YR 4/4) clay loam; weak coarse subangular blocky structure; firm; thin patchy brown (10YR 4/3) clay films on few vertical faces of peds; 3 percent rounded, 2 to 5 millimeter pebbles; slightly acid; clear wavy boundary.

IIB3—48 to 56 inches; dark brown (7.5YR 3/2) clay loam; weak coarse subangular blocky structure; firm; 5 percent 2 to 5 millimeter pebbles; neutral; clear irregular boundary.

IIIC1—56 to 65 inches; yellowish brown (10YR 5/4) and brown (10YR 5/3) stratified gravelly loamy sand; single grained; loose; strong effervescence; moderately alkaline.

The solum ranges from 40 to 70 inches in thickness.

The Ap horizon has hue of 10YR, value of 2 or 3, and chroma of 2. It is silt loam or loam. The A12 horizon, where present, is the same color and texture.

The B1 horizon has hue of 10YR, value of 3 to 5, and chroma of 3 or 4. It is silt loam or light silty clay loam. The B2t horizon has hue of 10YR, value of 4 or 5, and chroma of 3 or 4. It is silt loam or silty clay loam. The IIB horizon has hue of 10YR or 7.5YR, value of 3 to 5, and chroma of 2 to 4. It is clay loam or loam.

The IIIC horizon is gravelly loamy sand or stratified sand and gravel.

Wynn series

The Wynn series consists of moderately deep, well drained soils on uplands. These soils have moderately slow or slow permeability. They formed in a thin layer of loess, in glacial till, and the underlying residuum from calcareous clay shale and limestone bedrock. Slope is 2 to 18 percent.

Wynn soils are commonly adjacent to Eden soils. Wynn soils differ from Eden soils because part or all of the B horizon of Wynn soils developed in glacial till and the B horizon of Eden soils developed in residuum of clay shale and limestone. Wynn soils are also commonly adjacent to Miamian-Russell, bedrock substratum, soils on similar positions on the landscape. Wynn soils have bedrock at a depth of 20 to 40 inches; the latter soils are more than 40 inches to stony till over bedrock. In addition, Miamian and Russell soils commonly have a thicker mantle of loess.

Typical pedon of Wynn silt loam, 6 to 12 percent slopes, moderately eroded, about 0.8 mile southeast of Somerville, Milford Township, T. 5 N., R. 2 E., section 2,

from southwest corner, 1,580 feet north and 1,075 feet east:

Ap—0 to 8 inches, brown (10YR 4/3) silt loam; weak fine granular structure; friable; many roots; neutral; abrupt smooth boundary.

B1—8 to 12 inches; dark yellowish brown (10YR 4/4) silty clay loam; moderate fine and medium subangular blocky structure; friable; common roots; slightly acid; clear smooth boundary.

B21t—12 to 16 inches; brown (7.5YR 4/4) heavy silty clay loam; moderate medium subangular blocky structure; firm; common roots; thin patchy dark brown (7.5YR 4/2) clay films; 2 percent fine till pebbles; slightly acid; clear wavy boundary.

IIB22t—16 to 21 inches; dark reddish brown (5YR 3/4) clay; moderate coarse subangular blocky structure; firm; common small roots; thin very patchy dark brown (7.5YR 4/2) clay films, fine root channels and voids lined with dark brown (7.5YR 4/2) coatings; 8 percent coarse fragments including 3 percent limestone fragments; neutral; clear wavy boundary.

IIB23t—21 to 26 inches; dark reddish brown (5YR 3/4) clay; moderate coarse subangular blocky structure; firm; few roots; thin very patchy dark brown (7.5YR 4/2) clay films; 10 percent coarse fragments including 4 percent limestone fragments; neutral; clear wavy boundary

IIB3—26 to 29 inches; 70 percent dark reddish brown (5YR 3/4) and 30 percent light olive brown (2.5Y 5/4) clay; weak coarse subangular blocky structure; firm; few roots; 10 percent coarse fragments including 4 percent limestone fragments; neutral; clear smooth boundary.

IIIC—29 to 33 inches; 65 percent olive brown (2.5Y 4/4) clay and 35 percent dark reddish brown (5YR 3/4) heavy clay loam; massive; firm; olive brown material has strong effervescence, dark reddish brown material has slight effervescence; 10 percent thin limestone fragments; abrupt smooth boundary.

IIICr—33 to 45 inches; interbedded calcareous olive brown (2.5Y 4/4) clay shale and dark gray (10YR 4/1) thin bedded strata of limestone that is jointed, fossiliferous, and of Ordovician age.

The solum ranges from 20 to 40 inches in thickness; a paralithic contact is within a depth of 40 inches. The upper part of the solum formed in a thin loess mantle that ranges from 10 to 22 inches in thickness, the most common thickness is about 12 to 18 inches. There are no coarse fragments in the upper part of the solum that formed in loess, and coarse fragments range from 2 to 15 percent in the horizons formed in till. The Bt horizon formed principally from glacial till containing a component of local limestone and shale. The upper part of the solum is strongly acid to neutral, and the lower part is neutral to moderately alkaline.

The Ap horizon is dark brown (10YR 4/3) or dark grayish brown (10YR 4/2). Undisturbed areas have an A1 horizon that is 2 to 5 inches thick and is very dark grayish brown (10YR 3/2) or very dark brown (10YR 2/2); these areas also have an A2 horizon that is 3 to 6 inches thick, brown (10YR 5/3) or pale brown (10YR 6/3), and has weak platy structure. The A horizon is commonly silt loam; in moderately eroded areas it is silty clay loam and in severely eroded areas it is clay loam.

The B horizon ranges from dark yellowish brown (10YR 4/4) to dark reddish brown (5YR 3/4). Coatings have hue of 7.5YR or 10YR, value of 4 or 5, and chroma of 2 to 4. Texture of the B2 and B3 horizons is heavy clay loam, heavy silty clay loam, silty clay or clay. The B3 horizon extends into calcareous till or residuum from Ordovician material.

The C horizon typically is calcareous clay residuum from shale but is calcareous clay loam till in places. Skeletal material of limestone fragments or till pebbles make up as much as 50 percent of volume. The Cr horizon consists of interbedded calcareous shale on thin jointed strata of limestone with the shale predominating.

Xenia series

The Xenia series consists of deep, moderately well drained soils on glacial till plains and in till filled valleys. These soils formed in a mantle of loess and the underlying calcareous glacial till over Ordovician bedrock in many areas. They have moderately slow permeability. Slope is 0 to 6 percent.

Xenia soils are commonly adjacent to Fincastle and Russell soils. Fincastle soils are dominantly 2 in chroma below the Ap horizon and Russell soils lack 2-chroma mottles in the upper 10 inches of the argillic horizon.

Typical pedon of Xenia silt loam, 2 to 6 percent slopes, about 3 miles south of Monroe, Liberty Township, R. 3, T. 3, section 9, from southwest corner, 430 feet north and 2,190 feet east:

Ap—0 to 6 inches; dark grayish brown (10YR 4/2) silt loam; weak fine granular structure; friable; neutral; clear smooth boundary.

B&A—6 to 10 inches; brown (10YR 5/3) (B, 60 percent) and grayish brown (10YR 5/2) (A, 40 percent) heavy silt loam; weak fine and medium subangular blocky structure; friable; slightly acid; abrupt smooth boundary.

B21t—10 to 14 inches; dark yellowish brown (10YR 4/4) silty clay loam; moderate fine and medium subangular blocky structure; friable; thin patchy grayish brown (10YR 5/2) clay films on surfaces of peds; medium acid; clear smooth boundary.

B22t—14 to 20 inches; dark yellowish brown (10YR 4/4) silty clay loam; common medium distinct grayish brown (10YR 5/2) and yellowish brown (10YR 5/6) mottles; moderate medium subangular blocky struc-

ture; firm; thin patchy grayish brown (10YR 5/2) clay films on surfaces of peds; medium acid; clear wavy boundary.

123t—20 to 25 inches; dark yellowish brown (10YR 4/4) and yellowish brown (10YR 5/6) silty clay loam; common fine distinct grayish brown (10YR 5/2) mottles; moderate medium subangular blocky structure; firm; thin patchy grayish brown (10YR 5/2) clay films on surfaces of peds; common small very dark brown (10YR 2/2) iron-manganese concretions; medium acid; clear wavy boundary.

IB24t—25 to 31 inches; yellowish brown (10YR 5/4 and 5/6) silty clay loam; few fine faint grayish brown (10YR 5/2) mottles; moderate coarse subangular blocky structure; firm; thin very patchy grayish brown (10YR 5/2) clay films on surfaces of peds; few fine very dark brown (10YR 2/2) iron-manganese concretions; 2 percent fine angular till pebbles; neutral; clear smooth boundary.

IB3—31 to 37 inches, dark yellowish brown (10YR 4/4) clay loam; few medium distinct yellowish brown (10YR 5/6) and grayish brown (10YR 5/2) mottles; weak coarse subangular blocky structure; firm; 5 percent fine angular till pebbles in upper part and limestone segregations in lower part of horizon; mildly alkaline; abrupt irregular boundary.

IC -37 to 72 inches; olive brown (2.5YR 4/4) light clay loam; many medium distinct grayish brown (2.5YR 5/2) mottles; massive; firm; 8 percent angular till pebbles; strong effervescence; moderately alkaline.

The thickness of the solum and depth to carbonates anges from 36 to 50 inches. The loess cap ranges from 12 to 36 inches in thickness.

The Ap horizon is 10YR 4/2 or 10YR 3/4. It ranges rom medium acid to neutral. It is silt loam.

The B2 horizon is 10YR 4/4, 10YR 5/4, or 10YR 4/3. It is silty clay loam. The IIB2 horizon and IIB3 horizons orned in till and are similar to the B2 horizon in color, ut are clay loam.

The C horizon is clay loam or loam till.

Formation of the soils

This section has two main parts. First, the important ctors of soil formation are discussed as they relate to e formation of soils in Butler County. Next, the processes of formation of soil horizons are described.

actors of soil formation

The important factors in soil formation are parent material, climate, living organisms, topography, and time. Climate and living organisms, particularly vegetation, e the active factors in soil formation. Their effect on e parent material is modified by topography and by the length of time the parent material has been acted upon. The relative importance of each factor differs from place to place. In some places, one factor dominates and is responsible for most of the soil properties, but normally, the interaction of all five factors determines the kind of soil that forms in any given place.

Parent material

Most soils in Butler County formed in glacial materials of Wisconsin age or Illinoian age. These materials consist of glacial till, outwash material, loess, and silty and clayey lacustrine material.

Some soils formed in alluvial material washed from uplands. The Eden soils formed in residuum weathered from interbedded shale and limestone. They commonly contain many limestone flagstones and have the steeper slopes (*5*).

The Miamian, Russell, Xenia, and Fincastle soils formed in Wisconsin age glacial till covered with loess of variable thickness. These soils are deep because they formed in thick soil materials. The Miamian soils generally are only moderately deep to carbonates because they lack a thick loess cap. Russell, Xenia, and Fincastle soils are deeper to carbonates than Miamian soils and have a thicker loess cap. The underlying glacial till is 20 to 40 percent calcium carbonate, a relatively high percentage. Uniontown, Patton, and Henshaw soils have a high content of silt because they formed in silty sediments deposited in areas that ponded in postglacial time. Warsaw and Eldean soils are moderately deep over calcareous sand and gravel because they formed in Wisconsin age outwash materials. Ockley and Wea soils formed in thicker materials similar to that underlying the Warsaw and Eldean soils. The Avonburg and Rossmoyne soils are weathered to greater depths, because they formed in older Illinoian age glacial materials.

Some soils in the county formed in material that washed from other soils and was deposited on bottom lands. Because this material is continually deposited, soils on bottom lands show little or no profile development. Ross, Genesee, Eel, and Shoals soils formed on bottom lands in thick silty and loamy deposits. They are nearly neutral in reaction because their parent material washed from calcareous till. The sandy Stonelick and Landes soils formed in coarser textured sediments than Ross, Genesee, and similar soils.

Climate

Climate affects the development of soils in several ways in Butler County. Rainfall and temperature have favored plant growth, and most of the soils have a surface layer than contains significant amounts of organic matter. The surface layer of Ragsdale, Brookston, Patton, and other soils is dark colored because it has a large accumulation of organic matter as is characteristic in a local wet microclimate. Most of the parent material

TABLE 14.--ENGINEERING PROPERTIES AND CLASSIFICATIONS--Continued

Soil name and map symbol	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Frag-ments > 3 inches	Percentage passing sieve number--: 4	10	40	200	Liquid limit	Plas-ticity index
	In				Pct					Pct	
UsA*: Urban land.											
Patton	0-13	Silty clay loam	CL	A-6	0	100	100	95-100	75-95	30-40	10-20
	13-36	Silty clay loam	CL, CH, ML, MH	A-7	0	100	100	95-100	80-100	40-55	15-25
	36-65	Stratified silt loam to silty clay loam.	CL	A-6	0	100	100	95-100	75-95	25-40	10-20
WbA Warsaw	0-17	Loam	CL, CL-ML	A-4, A-6	0	80-100	75-100	70-100	50-90	25-35	4-12
	17-29	Sandy clay loam, loam, gravelly clay loam.	SC, CL	A-6, A-2-6	0-3	90-95	70-95	60-90	30-70	35-35	10-20
	29-32	Gravelly sandy clay loam, gravelly loam.	CL, SC, GC	A-6, A-2-6	0-5	70-90	60-85	55-70	30-60	25-35	10-15
	32-60	Stratified sand to very gravelly sand.	SP, GP, SP-SM, GP-GM	A-1	1-5	30-70	22-55	7-20	2-10	<20	NP
WeA, WeB Wea	0-14	Silt loam	CL, CL-ML	A-4, A-6	0	100	100	90-100	70-90	25-35	5-15
	14-56	Silty clay loam, clay loam, silt loam.	CL	A-6, A-7	0	95-100	90-95	85-95	65-90	35-50	15-30
	56-65	Stratified sand to gravelly sand.	SP, SP-SM, GP, GP-GM	A-1	1-5	30-70	20-55	5-20	0-10	---	NP
WyB, WyB2, WyC2 Wynn	0-8	Silt loam	CL-ML, CL	A-4, A-6	0	100	100	85-100	80-90	24-38	5-15
	8-16	Silty clay loam, clay loam.	CL	A-6, A-7	0	100	100	75-100	70-95	30-50	15-30
	16-33	Clay, silty clay loam, clay loam.	CL, CH	A-6, A-7	0-10	95-100	80-100	75-95	70-95	30-55	15-35
	33-45	Weathered bedrock.	---	---	---	---	---	---	---	---	---
WzC3 Wynn	0-8	Silty clay loam	CL	A-6, A-7	0	100	100	85-100	80-95	30-45	15-25
	8-16	Silty clay loam, clay loam.	CL	A-6, A-7	0	100	100	75-100	70-95	30-50	15-30
	16-33	Clay, silty clay loam, clay loam.	CL, CH	A-6, A-7	0-10	95-100	80-100	75-95	70-95	30-55	15-35
	33-45	Weathered bedrock.	---	---	---	---	---	---	---	---	---
WuB*, WuC*: Wynn	0-8	Silt loam	CL-ML, CL	A-4, A-6	0	100	100	85-100	80-90	24-38	5-15
	8-16	Silty clay loam, clay loam.	CL	A-6, A-7	0	100	100	75-100	70-95	30-50	15-30
	16-33	Clay, silty clay loam, clay loam.	CL, CH	A-6, A-7	0-10	95-100	80-100	75-95	70-95	30-55	15-35
	33-45	Weathered bedrock.	---	---	---	---	---	---	---	---	---
Urban land.											
XeA, XeB, XeB2 Xenia	0-10	Silt loam	CL, CL-ML	A-4, A-6	0	100	100	90-100	70-100	25-35	5-15
	10-31	Silty clay loam	CL	A-6, A-7	0	100	100	90-100	80-95	35-50	15-30
	31-72	Loam, clay loam	CL, ML, SC, SM	A-4, A-6	0-5	85-95	80-90	75-90	40-65	15-30	NP-15
XfA, XfB, XfB2 Xenia	0-8	Silt loam	CL, CL-ML	A-4, A-6	0	100	100	90-100	70-100	25-35	5-15
	8-26	Silty clay loam	CL	A-6, A-7	0	100	100	90-100	80-95	35-50	15-30
	26-42	Clay loam, silty clay loam.	CL	A-6, A-7	0-5	92-100	90-95	75-95	65-75	35-50	15-30
	42-59	Stony clay loam	CL	A-6, A-7	15-30	85-95	75-90	70-85	55-75	30-50	15-35
	59	Weathered bedrock.	---	---	---	---	---	---	---	---	---

* See map unit description for the composition and behavior of the map unit.

TABLE 15.--PHYSICAL AND CHEMICAL PROPERTIES OF SOILS--Continued

Soil name and map symbol	Depth	Permeability	Available water capacity	Soil reaction	Shrink-swell potential	Erosion factors K	Erosion factors T	Wind erodibility group
	In	In/hr	In/in	pH				
UsA*: Urban land.								
Patton----------	0-13	0.6-2.0	0.21-0.23	6.6-7.3	Moderate------	0.28	5	7
	13-36	0.6-2.0	0.18-0.20	6.1-7.8	Moderate------	0.28		
	36-65	0.6-2.0	0.18-0.22	7.4-7.8	Moderate------	0.28		
WbA---------- Warsaw	0-17	0.6-2.0	0.20-0.24	5.6-7.3	Low----------	0.28	4-3	5
	17-29	0.6-2.0	0.16-0.19	5.1-7.8	Low----------	0.28		
	29-32	0.6-2.0	0.15-0.17	6.6-8.4	Low----------	0.28		
	32-60	>20	0.02-0.04	7.9-8.4	Low----------	0.10		
WeA, WeB--------- Wea	0-14	0.6-2.0	0.20-0.24	5.1-6.5	Low----------	0.32	5-4	5
	14-56	0.6-2.0	0.15-0.20	5.1-6.5	Moderate------	0.43		
	56-65	>20	0.02-0.04	7.4-8.4	Low----------	0.10		
WyB, WyB2, WyC2-- Wynn	0-8	0.6-2.0	0.22-0.24	5.1-7.3	Low----------	0.37	3-2	5
	8-16	0.2-0.6	0.15-0.20	5.1-7.3	Moderate------	0.37		
	16-33	0.06-0.6	0.09-0.18	6.1-8.4	Moderate------	0.37		
	33-45	---	---	---	----------	---		
WyC3---------- Wynn	0-8	0.6-2.0	0.21-0.23	5.1-7.3	Moderate------	0.37	3-2	7
	8-16	0.2-0.6	0.15-0.20	5.1-7.3	Moderate------	0.37		
	16-33	0.06-0.6	0.09-0.18	6.1-8.4	Moderate------	0.37		
	33-45	---	---	---	----------	---		
WuB*, WuC*:								
Wynn----------	0-8	0.6-2.0	0.22-0.24	5.1-7.3	Low----------	0.37	3-2	5
	8-16	0.2-0.6	0.15-0.20	5.1-7.3	Moderate------	0.37		
	16-33	0.06-0.6	0.09-0.18	6.1-8.4	Moderate------	0.37		
	33-45	---	---	---	----------	---		
Urban land.								
XeA, XeB, XeB2--- Xenia	0-10	0.6-2.0	0.22-0.24	6.6-7.3	Low----------	0.37	5	5
	10-31	0.2-0.6	0.18-0.20	5.1-6.0	Moderate------	0.37		
	31-72	0.2-2.0	0.05-0.19	7.9-8.4	Low----------	0.37		
XfA, XfB, XfB2--- Xenia	0-8	0.6-2.0	0.22-0.24	6.6-7.3	Low----------	0.37	5	5
	8-26	0.2-0.6	0.18-0.20	5.1-6.0	Moderate------	0.37		
	26-42	0.2-0.6	0.15-0.19	5.1-7.3	Moderate------	0.37		
	42-59	0.2-0.6	0.04-0.08	7.9-8.4	Moderate------	0.37		
	59	---	---	---	----------	---		

* See map unit description for the composition and behavior of the map unit.

TABLE 16.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydrologic group	Flooding			High water table			Bedrock		Potential frost action	Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months	Depth	Hardness		Uncoated steel	Concrete
					Ft			In				
UnA, UnB---------- Uniontown	B	None--------	---	---	2.5-6.0	Apparent	Nov-May	>60	---	High-----	Low------	Moderate.
UpA*: Urban land.												
Eldean----------	B	None--------	---	---	>6.0	---	---	>60	---	Moderate	High-----	Moderate.
UsA*: Urban land.												
Patton----------	B/D	None--------	---	---	0-2.0	Apparent	Mar-Jun	>60	---	High-----	High-----	Low.
WbA---------- Warsaw	B	None--------	---	---	>6.0	---	---	>60	---	Moderate	Low------	Moderate.
WeA, WeB---------- Wea	B	None--------	---	---	>6.0	---	---	>60	---	Moderate	Moderate	Moderate.
WyB, WyB2, WyC2, WzC3---------- Wynn	B	None--------	---	---	>6.0	---	---	20-40	Rippable	Moderate	High-----	Low.
WuB*, WuC*: Wynn----------	B	None--------	---	---	>6.0	---	---	20-40	Rippable	Moderate	High-----	Low.
Urban land.												
XeA, XeB, XeB2---- Xenia	B	None--------	---	---	2.0-6.0	Apparent	Mar-Apr	>60	---	High-----	High-----	Moderate.
XfA, XfB, XfB2---- Xenia	B	None--------	---	---	2.0-4.0	Perched	Mar-Apr	48-72	Rippable	High-----	High-----	Moderate.

* See map unit description for the composition and behavior of the map unit.

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Sheet1

PICTURE NUMBER	LOCATION NUMBER	LOOKING	SAMPLE NO
1	1	EAST	MPS-CH-046
2	1	EAST	" " "
3	1	WEST	" " "
4	1	WEST	" " "
5	2	NORTH	MPS-CH-047
6	2	NORTH	" " "
7	2	SOUTH	" " "
8	2	SOUTH	" " "
9	3	NORTH	MPS-CH-048
10	3	NORTH	" " "
11	3	SOUTH	" " "
12	3	SOUTH	" " "
13	4	SOUTH	MPS-CH-049
14	4	SOUTH	" " "
15	4	WEST	" " "
16	4	WEST	" " "

ENCL 5

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TABLE 1: ON-SITE BACKGROUND SAMPLING RESULTS FOR THE KIMBLE SITE

Sample ID	Grid Location (coordinates in feet)	Depth	U-238 (pCi/g)	Total U (pCi/g)		Chromium (mg/kg)	Arsenic (mg/kg)
KPS-CH-046A	N 146, E 279	0.5	1.5	3.00	MDA	19.2	16.1
KPS-CH-046B		1.0				18.3	18.8
KPS-CH-046D		2.0				12.1	10.9
KPS-CH-046F		3.0				11.3	29.5
KPS-CH-047A	N 314, E 190	0.5	1.7	3.40	MDA	14.0	10.3
KPS-CH-047B		1.0				13.5	8.4
KPS-CH-047D		2.0				10.3	8.1
KPS-CH-047F		3.0				7.4	7.3
KPS-CH-048A	N 551, E 266	0.5	1.8	3.60	MDA	15.6	9.4
KPS-CH-048B		1.0				13.3	10.0
KPS-CH-048D		2.0				10.2	6.9
KPS-CH-048F		3.0				10.6	15.4
KPS-CH-049A	N 1070, E 260	0.5	1.8	3.60	MDA	9.9	8.8
KPS-CH-049B		1.0				9.9	7.3
KPS-CH-049D		2.0				20.9	15.8
KPS-CH-049F		3.0				14.1	14.3
KPS-CH-053A	N 1115, E 33	0.5	1.4	2.80	MDA	8.3	9.2
KPS-CH-053B		1.0				9.1	7.9
KPS-CH-053D		2.0				21.3	24.5
KPS-CH-053F		3.0				9.6	11.3
					Average	12.9	12.5
					Standard Deviation	4.2	6.1
					Avg + 2 sigma	21.3	24.7

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To E. Skintik / D. Riley	From Axel John
Co. DOE - FEO	Co. Bechtel
Dept.	Phone # (423) 576-4898
Fax # (513) 648-3077	Fax # (423) 576-0410

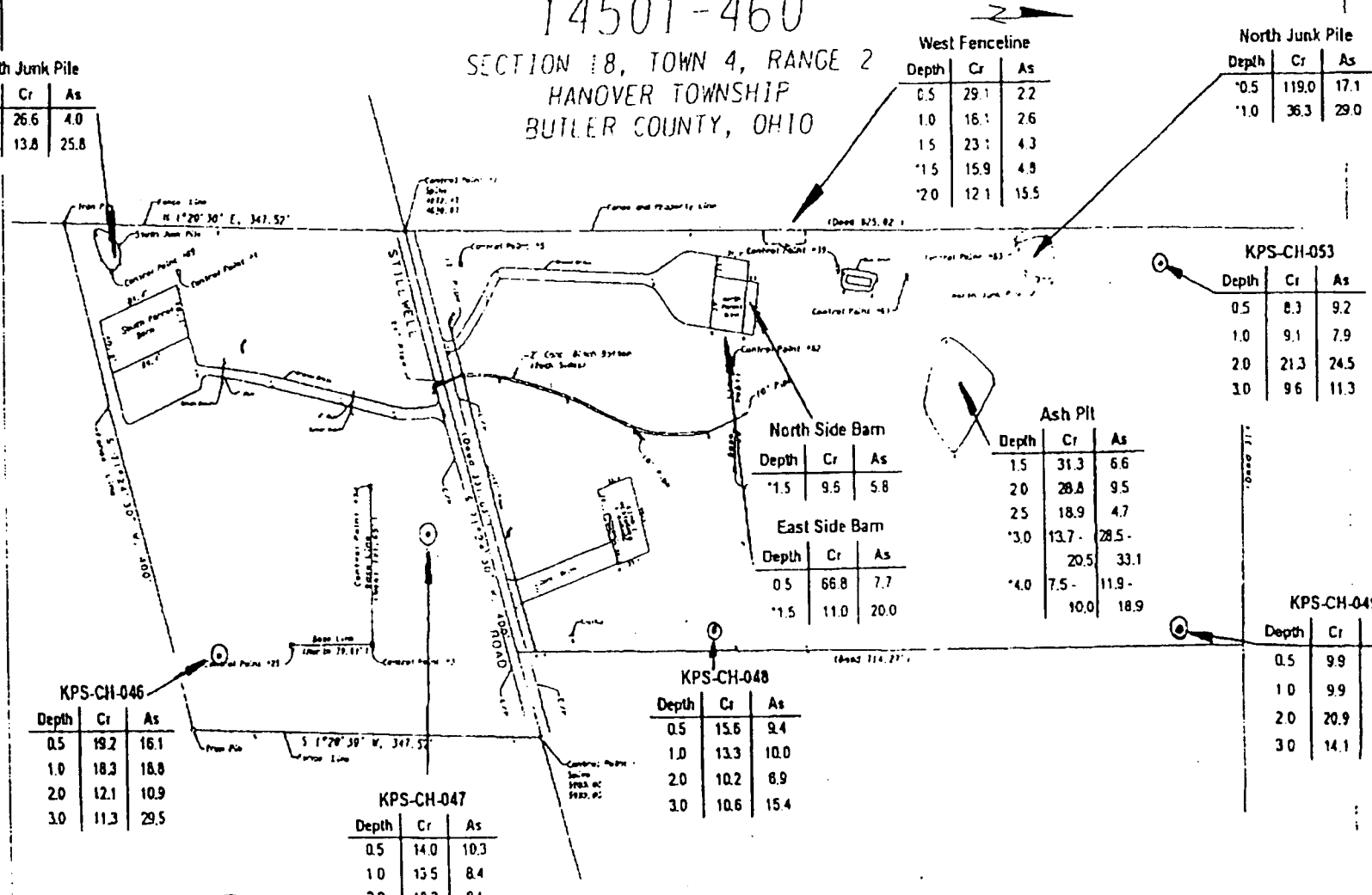
Soil Test Descriptions

Test Location	Soil Description
KPS-CH-046 (loc. 1)	0 to 6 inches; dark yellowish orange (10YR 6/6) silt loam (ML-CL, friable, with abundant roots and organic plant material. 6 to 24 inches; dark yellowish brown (10YR 4/2) silty clay loam (CL), firm, with some well rounded gravel and pebbles. 24 to 30 inches; grayish brown (5YR 3/2) silty clay loam (CL), firm, with some well rounded gravel and pebbles.
KSP-CH-047 (loc. 2)	0 to 6 inches; dark yellowish orange (10YR 6/6) silt loam (ML-CL), friable, with abundant roots and organic plant material. 6 to 12 inches; dark yellowish orange (10YR 6/6) silty clay loam (CL), firm, with some well rounded gravel and pebbles. 12 to 18 inches; dark yellowish brown (10YR 4/2) silty clay loam (CL), firm, with some well rounded gravel and pebbles.
KSP-CH-048 (loc. 3)	0 to 8 inches; olive gray (5Y 3/2) silt loam (ML-CL), friable, with abundant roots and organic plant material. 8 to 24 inches; light olive gray (5Y 5/2) silty clay loam (CL), firm, with some well rounded gravel and pebbles.
KSP-CH-049 (loc. 4)	0 to 6 inches; light olive gray (5YR 5/2) silt loam (ML-CL), friable, with abundant roots and organic plant material. 6 to 18 inches; light olive brown (5Y 5/6) silty clay loam (CL), firm, little plant roots, with some well rounded gravel and pebbles. 18 to 36 inches; olive gray (5Y 3/2) silty clay loam (CL), firm, trace plant roots, with some well rounded gravel and pebbles.
KSP-CH-053 (loc. 5)	0 to 6 inches; olive gray (5Y 3/2) silt loam (ML-CL), friable, with abundant roots and organic plant material, some gravel 6 to 18 inches; moderate olive brown (5Y 4/4) silty clay loam (CL), firm, with abundant roots and organic plant material, some gravel. 18 to 24 inches; olive gray (5Y 3/2) silty clay loam (CL), firm, trace well rounded gravel and pebbles.

It has been a pleasure to support you on this task. Please advise if you have any question or need additional information.

SITE SURVEY
KIMBLE PROPERTY
14501-460

SECTION 18, TOWN 4, RANGE 2
HANOVER TOWNSHIP
BUTLER COUNTY, OHIO



South Junk Pile

Depth	Cr	As
*0.5	26.6	4.0
*1.0	13.8	25.8

West Fenceline

Depth	Cr	As
0.5	29.1	2.2
1.0	16.1	2.6
1.5	23.1	4.3
*1.5	15.9	4.8
*2.0	12.1	15.5

North Junk Pile

Depth	Cr	As
*0.5	119.0	17.1
*1.0	36.3	29.0

KPS-CH-053

Depth	Cr	As
0.5	8.3	9.2
1.0	9.1	7.9
2.0	21.3	24.5
3.0	9.6	11.3

North Side Barn

Depth	Cr	As
*1.5	9.5	5.8

East Side Barn

Depth	Cr	As
0.5	66.8	7.7
*1.5	11.0	20.0

Ash Pit

Depth	Cr	As
1.5	31.3	6.6
2.0	28.8	9.5
2.5	18.9	4.7
*3.0	13.7 - 20.5	28.5 - 33.1
*4.0	7.5 - 10.0	11.9 - 18.9

KPS-CH-049

Depth	Cr	As
0.5	9.9	8.8
1.0	9.9	7.3
2.0	20.9	15.8
3.0	14.1	14.3

KPS-CH-048

Depth	Cr	As
0.5	15.6	9.4
1.0	13.3	10.0
2.0	10.2	6.9
3.0	10.6	15.4

KPS-CH-047

Depth	Cr	As
0.5	14.0	10.3
1.0	13.5	8.4
2.0	10.3	8.1
3.0	7.4	7.3

KPS-CH-046

Depth	Cr	As
0.5	19.2	16.1
1.0	18.3	18.8
2.0	12.1	10.9
3.0	11.3	29.5

Concentrations are in mg/kg (ppm); depths are in feet

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SEPT 26, 1995

* - Indicates sample was a post-RA composite over the remediated area

⊙ - Indicates sampling location was selected to determine on-site background

ENCL 6

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Determination of the Background-Based Soil Clean-up Action Level for Arsenic at Kimble Property, Butler County, Ohio

The soil cleanup action level for arsenic at the Kimble property at Butler County, Ohio is determined based on the levels in background samples collected from the property soils. Statistical analyses are performed using the sample data, and following the guidance document "Closure Plan Review Guidance for RCRA Facilities" by the Ohio Environmental Protection Agency (OEPA, 1993). The action level for the cleanup of the property soils contaminated with arsenic from anthropogenic sources is determined to be 33 mg/kg. This arsenic concentration value for site soils for any depth is the 95 percentile upper confidence level of the 95 percentile of the background arsenic distribution at the property soils. The statistical analyses performed to derive the action level are summarized below, which include:

- Analysis of Variance (ANOVA) to determine the randomness of samples at various soil depths
- Normality test to determine the type of distribution of the background arsenic in soils
- Outlier test
- Fitting of Lognormal distribution to sample data
- Determination of the upper 95 percentile confidence level.

Sample Background Data

Arsenic is ubiquitous in natural soils. The background arsenic concentrations in sedimentary soils (shales and clays) range from 0.3 to 490 mg/kg (USEPA,1987). Since arsenic exists in soils as compounds attached to soils particles, the spatial and in-depth distribution of soil arsenic concentrations may exhibit high variation across a site depending on the degree of soil heterogeneity (soil type, texture, and structure) across the site. In order to determine the soil background arsenic concentrations across the Kimble Property, the soil samples were taken from five boreholes located on the property. The borehole locations which are shown on Figure 1 were selected to provide representative background soil samples for the property area, and in soil depths from 0.5 feet to 3.0 feet. These borehole sampling locations are:

- away from past waste management areas
- away from areas affected by surface runoff from waste management areas
- away from storm drains or ditches receiving industrial and urban runoff presently or historically
- away from any spill areas
- away from material handling areas

- away from fill areas.

At each borehole four soil samples were taken at 0.5-, 1-,2-, and 3-foot depths. Soils at all boreholes exhibit similar characteristics (0-6 inches silt-loam, and 6-36 inches silty clay loam in general), indicating homogeneous soils across the site (USDASCS,1980).

The arsenic concentrations at four soil depths at the five boreholes are shown on Figure 1, and the sample statistics are shown in Table 1.

Table 1- Sample Data Statistics

Count	20
Mean	12.51
Median	10.15
Mode	7.3
Standard Deviation	6.07
Sample Variance	36.85
Kurtosis	2.31
Skewness	1.4
Range	22.6
Minimum	6.9
Maximum	29.5

ANOVA Test

The ANOVA test was used to determine if the twenty arsenic samples can be considered as independently, and identically distributed random variables (a prerequisite for frequency distribution analysis) (Snedecor and Cochran, 1967). Since for each depth interval, the sample concentrations do not show any apparent spatial correlation, samples from the same soil depth can be considered random. Also, there is no apparent trends in concentrations with soil depth. The ANOVA test was set up to test the hypothesis that the mean arsenic concentration at each of the four soil depths are the same. Prior to performing the test, data was normalized by log-transformation. The result of the test is shown in Table 2 below (see the attachment for the excel worksheet).

Table 2.- Analysis of Variance

Source of Variation	SS	df	MS	F	Fcritical
Between Depths	0.3654	3	0.1218	0.668	3.23
Within Depths	2.9153	16	0.1822		
Total	3.2807	19			

The test variable, F, has a value (0.668) less than the critical value of 3.23 at the 5 % significance level. Therefore, the null hypothesis that mean arsenic concentrations are same for all of the four soil depths can not be rejected at 5% level of significance. Consequently, in the remaining analysis, the 20 sample points are considered independent, and identically distributed random variables (sample data from the same parent background arsenic population).

Normality Test

A normality test was performed for the sample data using the USEPA's SCOUT software (USEPA,1991). The Kolmogorov-Smirnov normality test at 5% significance level indicated that the test statistic (0.229) is greater than the Critical test value of 0.192 for the normal distribution assumption to be accepted. Therefore, the data is nonnormal with a skewness of 1.5. For the subsequent analysis, the skewness of the data was removed by log transforming the sample data points. With the log-transformed data, the Kolmogorov-Smirnov Normality test at the 5% significance level resulted in the value of test statistic of 0.13 which is less than the critical value of 0.192. Therefore the hypothesis that the log-transformed data is normal cannot be rejected; and the data is assumed to be a sample from a lognormal distribution.

Outlier Test

Following the Closure Plan Review Guidance for RCRA Facilities of the Ohio Environmental Protection Agency, an outlier test was performed using the log-transformed data to determine whether there is statistical evidence that an observation that appears extreme does not fit the distribution of the rest of the data. The upper and lower cutoff values for arsenic concentrations to be considered to be outliers were determined based on the upper quartile (75 percentile), and lower quartile (25 percentile), and the

interquartile range (upper quartile-lower quartile). The computed lower and upper cutoff values were 3 and 40 respectively (see the attachment for the excel worksheet). Since no data point is outside of this range, it was decided that there are no outliers in the data set.

Fitting Lognormal Distribution

A two-parameter lognormal distribution was fitted to the 20 data points by the method of moments and the method of maximum likelihood (Kite, 1977). The mean of the log of data is 2.4364, and the variance is 0.17267. Using the parameters of the fitted distribution the arsenic concentrations at 50, 80, 90, 95, 98, and 99 percentile points of the distribution were derived. The standard errors of these estimated percentile values were also computed using method of maximum likelihood. The derived percentile values and their corresponding standard errors are shown in Table 3 (see the attachment for the FORTRAN code for the lognormal distribution, and input and output files).

Table 3- Percentiles of the Background Arsenic Distribution

Percentile	Arsenic Concentration, mg/kg	Standard Error mg/kg
50	11.3	1.2
80	16.6	2.0
90	20.3	2.8
95	24.0	3.8
98	28.9	5.3
99	32.8	6.5

Determination of the Upper Confidence Level

In order to account for the sampling uncertainty 95 percentile upper confidence level was computed for the estimated percentile values of the background arsenic distribution in site soils. The upper confidence level was computed as the percentile value plus the standard error times the t-variate. The t-variate at 0.025 significance level (2-sided) and 19 degrees of freedom (sample size of 20 minus 1) is 2.433. The computed value of the upper confidence level for the 95th percentile of the distribution is then 33.2.

References

1. Kite, G.W. Frequency and Risk Analysis in Hydrology. Water Resources Publications. Fort Collins, Colorado, 1977.

2. Ohio Environmental Protection Agency. Closure Plan Review Guidance for RCRA Facilities, 1993

3. Snedecor, G.W. and William G. Cochran. Statistical Methods. Sixth Edition. The Iowa State University Press, Ames, Iowa, 1967.

4. United States Department of Agriculture Soil Conservation Service. Soil Survey of Butler County, Ohio, 1980.

5. United States Environmental Protection Agency. Arsenic. EPA-600/1-76-036, 1987.

6. United States Environmental Protection Agency. SCOUT software version 1.33. Environmental Monitoring Systems Laboratory, Las Vegas , Nevada, 1991.

Attachments:

1. EXCEL Sheet- ANOVA TEST

2. EXCEL Sheet- Outlier Test for Sample Data

3. Computer program (FORTRAN 77) to fit lognormal distribution to sample data, input and output

SITE SURVEY
KIMBLE PROPERTY
14501-460

SECTION 18, TOWN 4, RANGE 2
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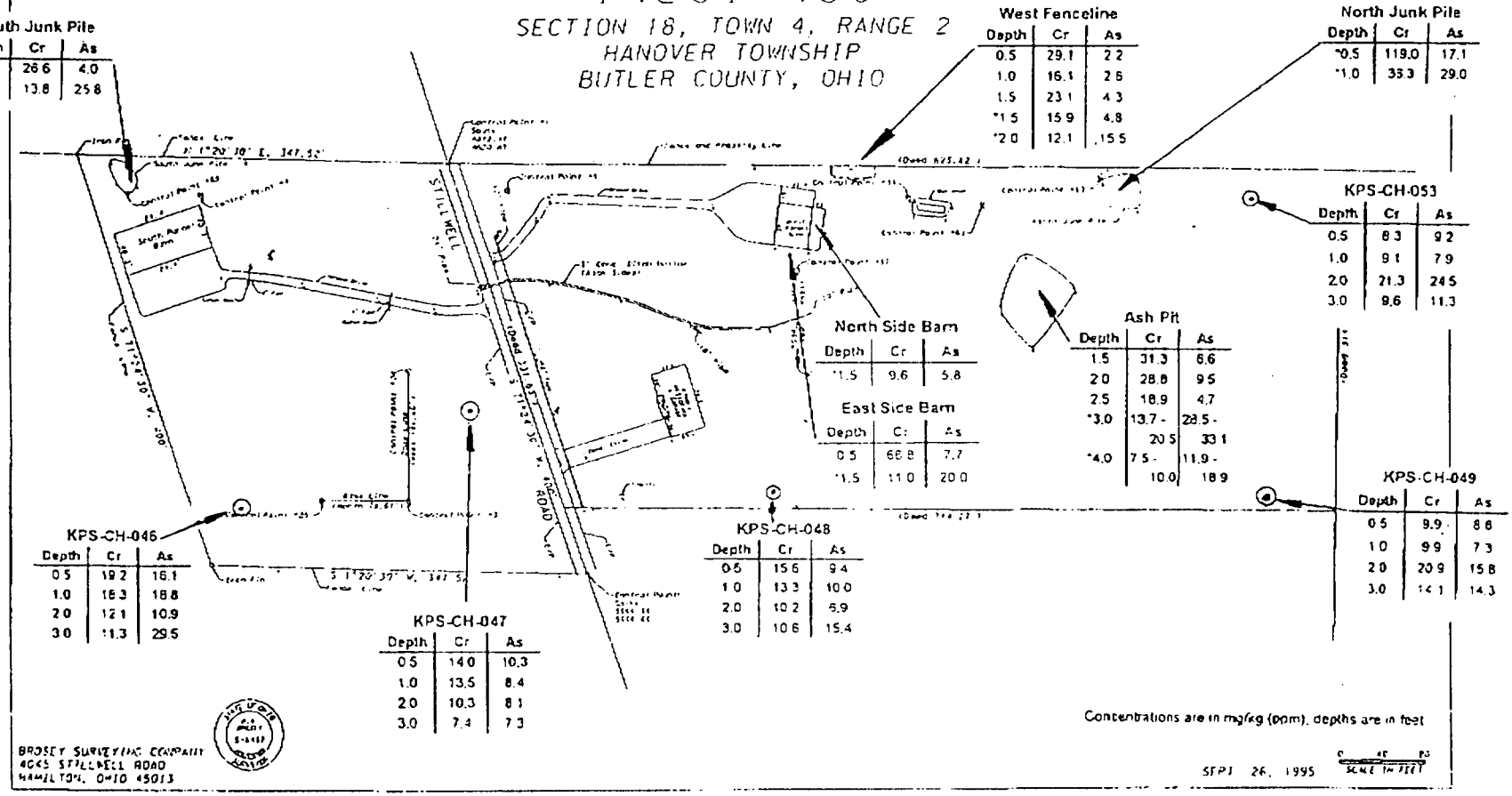
BUTLER COUNTY, OHIO



* - Indicates sample was a post-RA composite over the remediated area

⊙ - Indicates sampling location was selected to determine on-site background

FIGURE 1

ANOVA TEST

	Background Arsenic Data Set					
	Sample locations					
depth	CH-046	CH-047	CH-048	CH-049	CH-053	
0.5	16.1	10.3	9.4	8.8	9.2	
1	18.8	8.4	10	7.3	7.9	
2	10.9	8.1	6.9	15.8	24.5	
3	29.5	7.3	15.4	14.3	11.3	
Anova: Single Factor						
SUMMARY						
Groups	*Count*	*Sum*	*Average*	*Variance*		
0.5	5	53.8	10.76	9.213		
1	5	52.4	10.48	22.637		
2	5	66.2	13.24	51.358		
3	5	77.8	15.56	70.578		
ANOVA						
Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	85.094	3	28.3646667	0.73777	0.54477	3.238867
Within Groups	615.144	16	38.4465			
Total	700.238	19				
Perform test with Log-transformed values						
depth	CH-046	CH-047	CH-048	CH-049	CH-053	
0.5	2.778819272	2.332143895	2.24070969	2.174752	2.219203	
1	2.93385687	2.128231706	2.30258509	1.987874	2.066863	
2	2.388762789	2.091864062	1.93152141	2.76001	3.198673	
3	3.384390263	1.987874348	2.73436751	2.66026	2.424803	
Anova: Single Factor						
SUMMARY						
Groups	*Count*	*Sum*	*Average*	*Variance*		
0.5	5	11.74562806	2.34912561	0.060991		
1	5	11.41941078	2.28388216	0.145441		
2	5	12.37083132	2.47416626	0.263632		
3	5	13.19169438	2.63833888	0.258749		
ANOVA						
Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	0.365420552	3	0.12180685	0.668522	0.583595	3.238867
Within Groups	2.915252504	16	0.18220328			
Total	3.280673057	19				

Background Arsenic Data Analysis: Outlier Test for Sample Data

Kimble Property background sample arsenic data							
mg/kg			rank	value		percentile	logs
16.1			1	6.9		5	0.838849
18.8			2	7.3		10	0.863323
10.9			3	7.3		15	0.863323
29.5			4	7.9		20	0.897627
10.3			5	8.1		25	0.908485
8.4			6	8.4		30	0.924279
8.1			7	8.8		35	0.944483
7.3			8	9.2		40	0.963788
9.4			9	9.4		45	0.973128
10			10	10		50	1
6.9			11	10.3		55	1.012837
15.4			12	10.9		60	1.037426
8.8			13	11.3		65	1.053078
7.3			14	14.3		70	1.155336
15.8			15	15.4		75	1.187521
14.3			16	15.8		80	1.198657
9.2			17	16.1		85	1.206826
7.9			18	18.8		90	1.274158
24.5			19	24.5		95	1.389166
11.3			20	29.5		100	1.469822
Q75	1.187521						
Q25	0.908485						
Iqr	0.279036	(interquartile range)					
	logs	value					
UCutoff	1.606074	40.37144		Upper cutoff for outlier test			
LCutoff	0.489931	3.089808		Lower cutoff for outlier test			

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7536

COMPUTER PROGRAM (FORTRAN 77) TO FIT LOGNORMAL DISTRIBUTION TO SAMPLE DATA

```
c compute method of moment and maximum likelihood estimates
c for t-year events and standard errors for 2 parameter
c lognormal distribution
c input:
c title
c n number of events
c x series of events
c
c coded by Vefa Yucel, 1/26/96, reference: G.W. Kite, Frequency and Risk
c Analysis in Hydrology
c
      real*8 snd(6)
      real x(100)
      real*8 xt(6), sx(6)
      character*80 title
      real*8 k,m1,m2,m3,a,b,c,g,z,t,delta
      data snd/0..8416,1.2816,1.6449,2.0538,2.3264/
      read(5,100) title
      read(5,*) n
      xn=n
      read(5,*) (x(i),i=1,n)
      write(6,100) title
100   format(80a)
      write(6,*) '          2-parameter lgonormal distribution'
      write(6,*)
      write(6,*) '   input data '
      write(6,*) (x(i),i=1,n)
      write(6,12)
12    format(31x,17hmethod of moments.//)
      a=0.
      b=0.
      c=0.
      do 1 i=1,n
      a=a+x(i)
      b=b+x(i)**2.
      c=c+x(i)**3.
1     continue
      m1=a/xn
      m2=(b/xn)-(a/xn)**2
      m3=(c/xn)+2.*m1**3.-3.*m1*(b/xn)
      m2=m2*xn/(xn-1.)
      g=m3/(m2**1.5)
      write(6,5) m1
      write(6,6) m2
      write(6,7) g
5     format(20x,9hmean of x,16x,e12.5)
6     format(20x,13hvariance 0f x,16x,e12.5)
7     format(20x,9hskew of x,16x,e12.5,/)
      z=(dsqrt(m2))/m1
      a=dlog(1.+z**2)
      do 2 j=1,6
```

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```
      t=snd(j)
      k=(exp(dsqrt(a)*t-a/2.0)-1.0)/z
      xt(j)=m1+k*dsqrt(m2)
      delta=dsqrt(1.0+((z**3+3.*z)*k)+((z**8+6.*z**6+15.*z**4+16.*z**
     12+2.0)*k**2)/4.0)
2     sx(j)=delta*dsqrt(m2/xn)
      write(6,13)
      write(6,14) (xt(j),j=1,6)
      write(6,15) (sx(j),j=1,6)
13    format(3x,' Percentile   50  80  90  95  98  99',/)
14    format(3x,1hx,3x,6e12.5,/,4x,1ht)
15    format(3x,1hs,3x,6e12.5,/,4x,1ht,//)
      do 3 j=1,6
      t=snd(j)
      k=(exp(dsqrt(a)*t-a/2.0)-1.0)/z
      delta=dsqrt((a*((1.0+k*z)**2)*(1.0+(t**2)/2.0))/z**2)
3     sx(j)=delta*dsqrt(m2/xn)
      a=0.
      b=0.
      c=0.
      do 4 i=1,n
      x(i)=dlog(x(i))
      a=a+x(i)
      b=b+x(i)**2
      c=c+x(i)**3
4     continue
      m1=a/xn
      m2=(b/xn)-(a/xn)**2
      m3=(c/xn)+2.0*m1**3-3.0*m1*(b/xn)
      m2=m2*xn/(xn-1)
      g=m3/(m2**1.5)
      write(6,*)
      write(6,*) '   maximum likelihood procedure'
      write(6,*)
      write(6,17) m1
      write(6,18) m2
      write(6,19) g
      write(6,13)
      write(6,14) (xt(j),j=1,6)
      write(6,15) (sx(j),j=1,6)
      stop
17    format(20x,15hmean of ln(x)   ,10x,e12.5)
18    format(20x,19hvariance of ln(x)  ,6x,e12.5)
19    format(20x,15hskew of ln(x)  ,10x,e12.5,/)
      end
```

INPUT DATA

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Kimble Property- arsenic concentrations
20
16.1
18.8
10.9
29.5
10.3
8.4
8.1
7.3
9.4
10
6.9
15.4
8.8
7.3
15.8
14.3
9.2
7.9
24.5
11.3

OUTPUT

kimble Property- arsenic concentrations
2-parameter lgonormal distribution

input data

16.1000	18.8000	10.9000	29.5000	10.3000
8.40000	8.10000	7.30000	9.40000	10.0000
6.90000	15.4000	8.80000	7.30000	15.8000
14.3000	9.20000	7.90000	24.5000	11.3000

method of moments

mean of x 0.12510E+02
variance 0f x 0.36855E+02
skew of x 0.13690E+01

Percentile	50	80	90	95	98	99
x	0.11255E+02	0.16574E+02	0.20290E+02	0.23980E+02	0.28941E+02	0.32806E+02
t						
s	0.11731E+01	0.22712E+01	0.32567E+01	0.42774E+01	0.56763E+01	0.67762E+01
t						

maximum likelihood procedure

mean of ln(x)	0.24364E+01
variance of ln(x)	0.17267E+00
skew of ln(x)	0.73926E+00

Percentile	50	80	90	95	98	99
x t	0.11255E+02	0.16574E+02	0.20290E+02	0.23980E+02	0.28941E+02	0.32806E+02
s t	0.11573E+01	0.19832E+01	0.28157E+01	0.37823E+01	0.52473E+01	0.64941E+01